Response Rates Revisited

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Abstract

Response rates are an important indicator of survey quality and the potential for nonresponse bias. Until the American Association for Public Opinion Research (AAPOR) developed a standard definition for response rates in 1998, the survey research community used different formulas or rules to calculate them. By having a set of industry standards, response rates became easier to interpret and to compare across surveys. While this was a major improvement, the response rates (essentially one formula with six variations) were overly simplistic in terms of how they dealt with eligibility rates for those with undetermined eligibility status. The AAPOR standards give some guidance on computing the eligibility rate and applying the response rate formulas to more complex samples. This paper provides additional guidance and examples for estimating the eligibility rate, implementing the response rate formulas in complex samples, and applying multiple eligibility rates when eligibility is nested. This paper also provides alternative but algebraically equivalent response rate formulas for one-, two-, and three-stage samples, some of which may be easier to interpret or implement than the AAPOR versions.

Key Words: response rate, eligibility rate, complex samples, standards

1. Introduction

A response rate is the proportion of the eligible sample that has completed a survey. Survey response rates are one important measure of survey quality. They can give an indication of the success of survey operations and performance; they can be used for nonresponse weighting adjustments; weighted response rates can represent the proportion of the target population represented by the respondents; and response rates often can be correlated with the risk of nonresponse bias. While the concept of response rates is relatively simple in theory, in practice there are complexities in their calculation. Some response rates become complex due to the survey's sample design. But even the terms "eligible" and "complete" can require some thought. Because I calculate many response rates in my work, and help my colleagues calculate theirs, I have accumulated a set of thoughts, formulas, notes, and preferences when it comes to response rates, and have put a number of them in this paper in the hope that they are useful to others who construct response rates.

2. Standardization of Response Rates

In 1982, the Council of American Survey Research Organizations (CASRO) developed response rate guidelines for the data collection industry (CASRO, 1982). Most importantly, they proposed that sample members with undetermined eligibility status should be included in the rate's denominator, with an estimated eligibility rate applied to them. This eligibility rate could be based on that of the sample members whose eligibility status was known. This effort recommended in 1998 when the American Association for Public Opinion Research (AAPOR) published standards for final dispositions and outcome rates in surveys. These standards, which have been widely adopted, have been

revised a number of times, and are now published in their seventh edition (AAPOR, 2011). Other standards, such as those published by the United States Office of Management and Budget (OMB, 2006) and the Federal Committee on Statistical Methodology (FCSM, 2001), have provided similar sets of guidelines.

These efforts are to be applauded and undoubtedly have helped ensure that all survey organizations are reporting the rates in a consistent manner, making them comparable. The standards provide guidance on four types of outcome rates (response, cooperation, refusal, and contact), but in this paper I will focus on their response rate guidelines. I will also not discuss item response rates, and will use the term "response" throughout to mean unit response. The very first sentence of the AAPOR standards document states that the document is "a work in progress." All suggestions in this paper are intended to be constructive, and my hope is that they will be considered in a future edition of the guidelines.[1]

3. AAPOR Response Rates

The AAPOR standards divide all survey outcomes into four basic categories: (1) interview, complete or partial, (2) eligible case not interviewed ("nonrespondents"), (3) cases of unknown eligibility, and (4) cases not eligible. They present six response rate formulas, using the following notation:

RR = Response rate
I = Complete interview
P = Partial interview
R = Refusal and breakoff
NC = Noncontact
O = Other
UH = Unknown if household/occupied housing unit
UO = Unknown, other
e = Estimated proportion of cases of unknown eligibility that are eligible

Response Rate 1

$$RR1 = \frac{I}{(I+P) + (R+NC+O) + (UH+UO)}$$

Response Rate 2

$$RR2 = \frac{(I+P)}{(I+P) + (R+NC+O) + (UH+UO)}$$

Response Rate 3

$$RR3 = \frac{I}{(I+P) + (R+NC+O) + e(UH+UO)}$$

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[1] Note that most of the issues I raise about the AAPOR response rate guidelines also apply to the OMB and FCSM guidelines. The OMB and FCSM guidelines, however, do not unnecessarily break out the formulas into six versions.

Response Rate 4

$$RR4 = \frac{(I + P)}{(I + P) + (R + NC + O) + e(UH + UO)}$$

Response Rate 5

$$RR5 = \frac{I}{(I + P) + (R + NC + O)}$$

Response Rate 6

$$RR6 = \frac{(I + P)}{(I + P) + (R + NC + O)}$$

In all six rates, the numerator includes completed interviews, and the denominator includes completed interviews, refusals, and other incompletes (including noncontacts). The odd-numbered rates exclude partial completes from the numerator, and the even-numbered rates include them as completes in the numerator. Among the odd-numbered rates, response rate 1 assumes that all sample members with unknown eligibility status are eligible, thus being the minimum response rate among the set of three. Response rate 5 assumes that none of those with undetermined eligibility are eligible, thus maximizing the response rate. Response rate 3 falls between these two sets of assumptions, assigning to the undetermined cases an eligibility rate between 0 and 1. The same pattern holds for the three even-numbered formulas that include partial completes in the numerator, with rate 2 producing the minimum response rate among the three, rate 6 producing the maximum rate, and rate 4 falling in between.

4. Suggestions for Modification of AAPOR Response Rate Guidelines

Unfortunately, in practice I am rarely able to use these original formulas as they are, and find that they are overly complex in one respect and overly simplistic in several other respects. Some of the issues I have with the formulas have been dealt with in revisions to the surrounding *text*, but the formulas themselves remain unchanged and are therefore problematic for those who quickly reference only those formulas. In terms of my assertion that the formulas are overly complex, I contend that a single formula would suffice:

$$RR = \frac{I}{I + (R + NC + O) + e(UH + UO)} \qquad \text{where } 0 \leq e \leq 1$$

In this single formula, partial completes must be classified as either a complete or an incomplete. In my experience, whether a partial complete is considered a complete is generally dictated by how each case will be dealt with in analysis and in the weights, and is a survey- and case-specific decision. In the text of the AAPOR standards, there is a discussion of partial completes, which fall somewhere between breakoffs[2] and completed interviews, the rule for which should be determined *a priori*. But the number of AAPOR

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[2] Breakoffs are considered to be refusals after the interview commences. This can be during the introduction or after the interview is underway.

formulas double to allow for partial completes being in or out of the numerator, which is rarely a simple dichotomy in practice. And by allowing e, the estimated eligibility rate for the sampled cases with undetermined eligibility, to be 0 or 1, only one formula is needed.

Here is where the formulas are overly simplistic. If UH refers to those sample members for which it is undetermined whether they were housing units (which really only applies to telephone- or address-based samples[3]), and UO refers to those sample members for which it is undetermined whether they were otherwise eligible for the survey, then a single eligibility rate e would rarely be appropriate. Again, this is dealt with in the text of the standards (in a footnote), but not in the formulas. The household eligibility rate is likely to be quite different from the survey eligibility rate. If the former is represented by e_1 and the latter by e_2, I propose the following formula:

$$ RR = \frac{I}{I + (R + NC + O) + e_2(e_1 UH + UO)} \quad \text{where } 0 \le e_1 \le 1, 0 \le e_2 \le 1 $$

This formula assumes that a certain proportion of the UH cases are households, and that a proportion of *those* are survey-eligible. Of course, for list samples, the code UH is not applicable and should be omitted from the formula. In fact, it may be advisable to have a second response rate formula in the standards—one for list samples (of specifically named persons) and one for population-based samples based on a random selection of telephone numbers or addresses (that may or may not have survey eligibility criteria beyond being a household).

Looking at another part of the formula, the denominator contains $(R + NC + O)$, which are refusals, breakoffs (either during the introduction or after starting the survey), noncontacts, and other incompletes, which are all treated as eligible in the formula. But to determine whether a sampled case is eligible, it is usually necessary to get through the introduction and perhaps a few screener questions. Suppose the survey uses a random-digit-dial (RDD) sample in which one is trying to find a household with at least one person over the age of 65; or suppose the survey uses a list sample to identify people who are supposed to be been some type of program participant in the last year. Until someone answers a few questions about who lives in the household, or confirms that the sample member did in fact participate in the program last year, eligibility status is undetermined. This means that the household or person should be classified as having undetermined eligibility, and therefore should have an eligibility rate e_2 applied in the denominator. In fact, there could be different survey eligibility rates applied to various types of household nonrespondents, or various household eligibility rates applied to various types of unresolved household status cases (for example, noncontacts vs. breakoffs during the introduction).

In the text, the authors assert that, if eligibility status is undetermined, it should *not* be classified as a refusal, even if the person refused to answer the screening questions. In practice, survey operations will classify such cases with a refusal disposition, which means that each refusal (or breakoff or noncontact) should be further classified according to whether its eligibility status has been determined. Other classifications are puzzling. Noncontacts are classified as eligible non-interviews. If no contact is made, how then is eligibility status determined?

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[3] Or in the case of an establishment survey, whether or not the case is an establishment of the desired type.

The guidelines also include a set of tables of Final Disposition Codes for four different survey types: (1) RDD Telephone Surveys; (2) In-Person Household Surveys; (3) Mail Surveys of Specifically-Named Persons; and (4) Internet Surveys of Specifically-Named Person. *Table 1—Final Disposition Codes for RDD Telephone Surveys* includes a final disposition code of deceased (2.31) that has been included only in the Eligible Non-Interview category. It is not clear why a deceased code would be relevant in an RDD scenario. Even for list samples (specifically named persons),[4] while there may be some surveys in which a deceased sample member is to be considered eligible (depending on at what time point eligibility is defined), in my experience deceased sample members are more often considered to be ineligible. All of this should be reflected and clarified in the proposed disposition codes.

5. More Complicated Designs in the Guidelines

There is a discussion of unweighted vs. **weighted response rates** in the guidelines. The guidelines say that in certain instances (unequal selection probabilities, multistage samples, two-phase sampling for nonresponse), weighted response rates should be calculated. But the response rate formula presented in the middle of this discussion does not include weighted notation.

A formula for a **multistage response rate** calculation should also be included. The example presented in the text of the multistage sample design section involves an RDD survey in which all persons ages 18-44 in a household are of interest. This is a somewhat complicated example, as it may be difficult to know whether the household contains such persons unless the interviewer can get through the relevant household enumeration or composition questions. As the text states, most non-interviews would not have gotten this far, and would have to be estimated.

The discussion of response rates for **two-phase sampling** of nonrespondents is followed by a formula that could be clearer. The published formula is:

$$RR1w = \frac{Iw}{(Iw + Pw) + (Rw + NCw + Ow) + (UHw + UOw)}$$

with the *w* subscript denoting the corresponding counts weighted by the base weight.[5] While the text indicates how the second phase of sampling (50 percent, in their example) affects the formula, it could be better illustrated by something like this:

$$RR1w = \frac{Iw1 + 2Iw2}{\begin{pmatrix} (Iw1 + Pw1) + (Rw1 + NCw1 + Ow1) + e(UHw1 + UOw1) + \\ 2(Iw2 + Pw2) + (2Rw2 + NCw2 + Ow2) + e2(UHw2 + UOw2) \end{pmatrix}}$$

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[4] While the guidelines reference RDD sampling, in-person household surveys (area-based sampling), mail surveys (of specifically named persons), internet, establishment, and mixed mode surveys, there is no discussion of telephone surveys of specifically named persons—a common combination of sample type and mode. Perhaps the document can be reorganized based first on sample type (RDD or area-based population sample vs. list based sample for households or persons) (same for establishments) and then by mode of data collection (telephone, web, in-person, mail).

[5] It appears that the eligibility rate *e* was inadvertently omitted from the formula.

where the suffix 1 indicates those cases that were finalized as a complete or an incomplete before the phase 2 subsampling occurred, and the suffix 2 indicates incomplete cases that were not finalized at that point in time and subsampled for phase 2 efforts. Note that, depending on how subsampling for nonresponse is carried out, there may be no r*esolved* nonrespondents at the time of subsampling, in which case *Rw1, NCw1, Ow1, UHw1,* and *UOw1* may all be equal to zero. Cases that were unresolved and *not* subsampled do not appear in the formula, as they are represented by the subsampled cases and are therefore assigned a subsampling weight of 0.

6. Response Rate Equivalents

While there are a number of ways to estimate the eligibility rates e_1 and e_2, a common method is to use the approach proposed by CASRO; that is, to use the observed eligibility rate (among those with determined eligibility status) and apply it to those with undetermined status. Under this assumption, which can be conservative, there are several response rate formulas that can be shown to be algebraically equivalent to the AAPOR rates. I present them here in the hope that they may be more intuitive than the response rate formulas presented above, and may in fact be easier to construct. In fact, they usually can be mapped to the steps taken when adjusting sampling weights for nonresponse.

6.1 Scenario 1
The first scenario presented here is for the situation in which all nonrespondents have undetermined eligibility status. This happens when it is essential for the respondent to answer at least some of the survey questions to determine eligibility. First, I introduce some new notation for simplicity:

RR = Response rate
I = Complete interview
N = Refusal and breakoff (R) + Noncontact (NC) + Other (O) ***assumed to be eligible***
U = Unknown if household/occupied housing unit (UH) or Unknown other (UO)[6]
X = Ineligible
e = Estimated proportion of cases of unknown eligibility that are eligible

The single response rate formula suggested above then reduces to:

$$RR = \frac{I}{I + N + eU}$$

The eligibility rate can be shown as:

$$e = \frac{I + N}{I + N + X}$$

And the response rate can then be shown as:

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[6] This formula assumes one type of eligibility; that is, an RDD or address-based sample with no other eligibility requirements or a list-based sample.

$$RR = \frac{I}{I+N+\left(\dfrac{I+N}{I+N+X}\right)U}$$

If we assume that all nonrespondents have undetermined eligibility status, then N = 0, and the formula reduces to:

$$RR = \frac{I}{I+\left(\dfrac{I}{I+X}\right)U} = \frac{I+X}{I+X+U}$$

Put more simply, the response rate is calculated as the number of completes plus the number of ineligibles, divided by the entire sample.

6.2 Scenario 2

The second scenario shows a situation in which there is only one type of ineligibility (either a nonhousehold for RDD or area-based samples, or a survey-specific ineligibility, but not both). We start again with the formula using the CASRO-based eligibility rate:

$$RR = \frac{I}{I+N+\left(\dfrac{I+N}{I+N+X}\right)U}$$

But we can also think of the survey response rate as the product of an eligibility determination rate and the survey completion rate among those determined to be eligible:

$$\text{DETERMINATION RATE} \qquad \frac{I+N+X}{I+N+X+U}$$

$$\text{COMPLETION RATE AMONG KNOWN ELIGIBLES} \qquad \frac{I}{I+N}$$

$$\text{ALTERNATIVE RESPONSE RATE (RR') IS PRODUCT}$$

$$RR' = \left(\frac{I+N+X}{I+N+X+U}\right)\cdot\left(\frac{I}{I+N}\right)$$

With some algebra, we get: $\qquad \dfrac{I}{(I+N)\left(\dfrac{I+N+X}{I+N+X}\right)+(I+N)\left(\dfrac{U}{I+N+X}\right)}$

The product of the determination and completion rates reduces to the standard response rate with the CASRO-based eligibility rate.

6.3 Scenario 3

The third scenario allows for two levels of eligibility determination, the first one of which would be whether the sampled telephone number or address is associated with a

household, and the second associated with some type of survey-specific eligibility in a household. First, we introduce new notation:

I = Completed interview
N = Eligible incomplete interview
X1 = Survey-ineligible household
U1 = Household with undetermined survey eligibility
X2 = Not a household
U2 = Undetermined if a household

If we think of the survey response rate as a product of the household determination rate, the screener completion rate among households, and the survey completion rate among eligible households:

$$RR_{(2-level)} = \frac{I}{I + N + e1(U1 + e2 \cdot U2)}$$

$$e1 = \frac{I + N}{I + N + X1} \qquad e2 = \frac{I + N + X1 + U1}{I + N + X1 + U1 + X2}$$

HOUSEHOLD DETERMINATION RATE $\quad \dfrac{I + N + X1 + U1 + X2}{I + N + X1 + U1 + X2 + U2}$

SURVEY ELIGIBILITY DETERMINATION RATE (SCREENER COMPLETION RATE) AMONG KNOWN HOUSEHOLDS

$$\frac{I + N + X1}{I + N + X1 + U1}$$

COMPLETION RATE AMONG KNOWN ELIGIBLE HOUSEHOLDS $\quad \dfrac{I}{I + N}$

ALTERNATIVE RESPONSE RATE (RR") IS PRODUCT OF THREE RATES:

$$RR" = \left(\frac{I + N + X1 + U1 + X2}{I + N + X1 + U1 + X2 + U2}\right)\left(\frac{I + N + X1}{I + N + X1 + U1}\right)\left(\frac{I}{I + N}\right)$$

With algebra, this reduces to the 2-level RR formula shown above under this scenario, again using the CASRO-based eligibility rate.

7. Other Musings on Response Rates

Here are a few other miscellaneous thoughts and suggestions about response rates not already covered in the above sections.

The question of whether a sample member is ineligible can have two different answers, both legitimate, depending on the purpose for such a classification. Suppose a telephone survey is designed to represent people who graduated from college last year. If a sample member is discovered to have moved to Japan, the study protocol may say that people

who have moved out of the continental United States are out of scope (for logistical and budgetary reasons), and therefore ineligible for further data collection efforts. But the person is still part of the target population for weighting and response rate purposes. We often distinguish between these two definitions of ineligibility by using terms like "operationally" vs. "statistically" ineligible. It could be argued that the operationally ineligible (but statistically eligible) sample members should be excluded from unweighted response rates, but included as eligible in the weighted response rates.

Even when there are unequal selection probabilities for a sample, it can make sense to present unweighted, in addition to weighted, response rates. The unweighted rate can give a valid measure of the success of the data collection effort, regardless of how much of the population each sample member represents. But the weighted response rate is still needed to get a sense of the proportion of the population represented by the responding sample.

For panel surveys, it is important to present both the unit (wave-specific) and cumulative response rates across waves. For nested cross-sectional samples, it is common to present both marginal response rate (conditional on selection and response to prior stage) as well as the cumulative response rates across stages.

8. Conclusion

The survey research community has come a long way in its attempts to provide guidance and establish standards on survey outcomes, including response rates. The U.S. government requires that certain standards be met in terms of the method used to calculate response rates as well as thresholds below which an analysis of nonresponse bias is required. The effort spearheaded by CASRO and picked up by AAPOR and OMB to standardize and provide guidance has been well received and widely adopted. The first part of this paper provides some suggested improvements to the AAPOR guidelines. Most of these issues have already been raised, if not addressed, in one way or another in the revised text of the guidelines. But the response rate formulas themselves could use some revisions. In addition, the final disposition codes may be too detailed and categorized in ways that may not make sense for some surveys. The purpose of the second part of the paper was to share some equivalent response rate formulas that I hope may be more intuitive to others or easier to construct, and to share some other miscellaneous thoughts and suggestions about response rates.

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