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DIGITAL ENGAGEMENT RESEARCH WORKING GROUP

Survey Technical Guidance: Samples, Design and Analysis

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Executive summary

A simple survey can be done relatively easily and it can produce persuasive, informative results. There are, however, a number of technical considerations that will improve the quality and reliability of the results. High quality surveys produce evidence that stands up to scrutiny and can inform policy. It follows the principles of ethics, transparency, accountability and auditability. This document briefly outlines many of the key issues and supplies guidance on how to deal with them.

Sampling and question wording

- Ensure that the sample is randomly selected so that it is representative of the population that you want to study.
- If you want do statistical analysis, make the sample size large enough. This probably means a minimum of 400 respondents and a minimum of 800 is much better.
- Write simple, easily understood questions to avoid biased results.
- If you use questions that have been used in other surveys, you can compare your results to theirs. This is valuable if you want to compare your results to a national survey.
- Pretest your questions with a small number of people from the population of interest.
- In your cover letter, tell respondents who is conducting the survey, why, and give contact details if they want further information.

Analysis and reporting

- Know how large the difference between percentages must be in order to say that it is statistical significant given your sample size. Do not claim that smaller differences are important.
- Do not confuse correlation with causation (e.g. if higher Internet use is associated with lower marks this may not mean that Internet use reduces marks).
- Clearly label all graphs and tables, as well as all axes on graphs. To the extent possible, graphs and tables should be self-explanatory.
- Report percentages with a clear statement of the sample or subsample they refer to (e.g. Internet users age 16 and over; Users of social network sites age 25-34). This should be part of the label of each table or graph.

Accountability

- Report funding sources and any potential conflicts of interest.
- Explain how the respondents were selected.
- Report the exact wording of the questions and possible responses.
- Report what organization conducted the survey along with the dates and circumstances of data collection.
- If you summarize results for the press, provide access to the percentage tables from which you drew your reported findings.
- Ensure the full research report is available or provide contact details so that interested people can ask researchers about the data or the analysis

Technical guidance

Surveys have been conducted, in their modern form, for at least 75 years, and many books have been written about them. This brief document can't hope to duplicate the detail you would get from any one of a number of good books. This document is an overview. The goal of this document is to introduce you to crucial issues and give you relatively straightforward suggestions. It is not a substitute for in-depth knowledge and, at the end of the document, I suggest some books you can turn to for more detailed information.

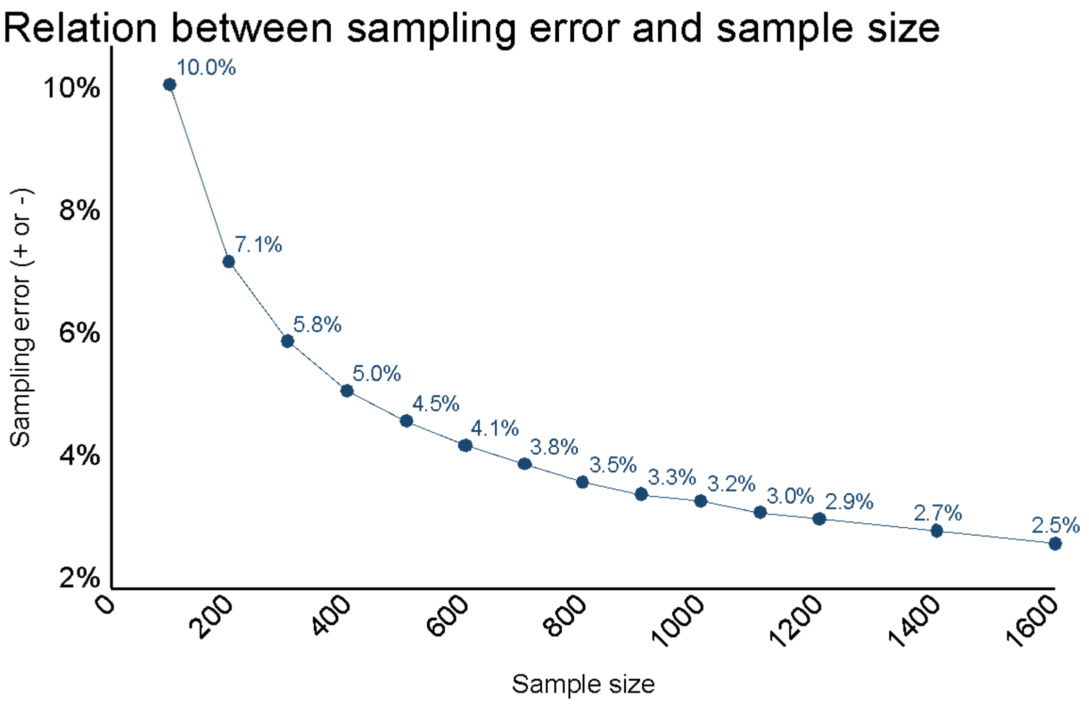
Sampling

Collecting data on whole populations is often too expensive and it is not necessary. You can answer almost all questions by selecting a sample, and it will be faster and cheaper. A sample is just a collection of people from the population that you wish to learn about. How these people are selected matters a great deal. A sample is valuable when it accurately represents the underlying population. To do this people in the sample must be selected *randomly*. "Random" has a very specific meaning: the selection is designed so that each person in the population has an equal chance of being selected. These samples are called "probability samples" because each member of the population has an equal probability of selection. The payoff from a probability sample is that the sample will be representative of the underlying population; that is, that the results you get from the sample can be generalized to the population. Random selection is the most important single element in the success of your survey. If you don't do this well, the rest doesn't matter because the results from the sample can't be generalized.

Results from non-probability samples cannot be generalized. Non-probability samples include self-selected or "convenience samples", including Internet opt-in surveys, call-in samples, person in the street surveys, and non-probability mail-in or telephone samples.

Sample size and sample error

Probability samples depend on two mathematical axioms: the law of large numbers and the central limit theorem. The central limit theorem says that if we draw a sample to measure something, say Internet use, the measurements will fall in a predictable, stable pattern around the true value in the population. This predictable pattern is the familiar bell-shaped curve, which is called a "normal distribution". The centre of a normal distribution is likely to be at the true value in the population. The law of large numbers says that the more people you have in the sample the closer your distribution will be to a bell-shaped curve. That is with a large sample, your results will be very close to the underlying population. How close your results come to the population is called the error in the sample or the "sampling error". Sampling error has a simple relationship to sample size: as sample size goes up, sampling error gets smaller. The relationship between sample size and sampling error can be described mathematically, as shown in the figure below.



The figure shows the size of the sampling error in percent for sample sizes between 100 and 1600 respondents. For example, it says that a sample of 400 respondents will have a sampling error of 5%. If you took a sample of 400 and found that 80% of them were Internet users, this says that the proportion of Internet users in the population would be 80% ±5%. Another way to say this is that your survey shows the proportion of Internet users is between 75% and 85%. The figure shows why the typical national poll samples about 1100-1200 people: For that sample size the margin of error is ±3%.

Sampling error has several characteristics that you should know to help understand it. First, it is a theoretical minimum. It assumes that you have drawn a truly random sample, where all members of the population had an equal probability of being included. Second, it is only one kind of error, but it is quantifiable and so it is often reported. Other errors will be discussed below. Third, it is not possible to calculate the sampling error of a non-probability sample. It is worth emphasizing again that all Internet polls in Britain are non-probability samples.

Finally, you often want to compare percentages; for example, voter preferences between Conservative and Labour in a political poll. In these cases it is important to remember that sampling error applies *not to the gap* between estimated percentages but to *each estimate*. Below is an example from the 2009 OxIS survey. This was a survey of 2,013 respondents, which had a margin of error of 2.2%. The table below shows that 71% of men are likely to use the Internet compared to 68% of women, a difference of three percentage points. This is outside the 2.2% margin of error. However, the possible range for men is 69% to 73%; for women it is 66% to 70%. Since the minimum estimate for men, 69%, is less than maximum estimate for women, 70%, these two ranges overlap. This says that men and women have about the same Internet use. Two groups are only different from each other if the difference between them is *more than twice the sampling error*.

Internet use by gender
2009 Oxford Internet Survey

Men 71%	Women 68%
Men 71% ± 2.2%	Women 68% ± 2.2%
Men 69% - 73%	Women 66% - 70%

Total survey error

Sampling error is one source of error. *Total survey error* comprises four sources:

- Sampling error. The sample may differ from the population.
- Coverage error. The sample may not map to the population.
- Non-response error. Many refuse to be surveyed.
- Measurement error. Question wording and order problems.

I have already discussed sampling error. I will discuss the other three in succession. The “sampling frame” is the name for list of all the people in the population from which you intend to draw the sample. The sampling frame should include every person in the population. Coverage error occurs when some people in the population were not included in the sampling frame. Because they were not included in the sampling frame they could not have been included in the sample. The problem with coverage error is that people excluded from sampling frame are almost never a random selection from the population. Instead they are typically people who are more marginal and harder to reach. In national samples they are poorer, less well-educated, possibly homeless or without a permanent address. People excluded from the sampling frame have zero probability of being included in the sample, thus the sample will not be a true reflection of the population. To the extent that the sample deviates from the population, the sample is said to be “biased”.

A second source of bias is non-response error. People may refuse to participate in the survey for many reasons; the problem is that typically they do not refuse at random. The people who refuse are systematically different from the people who agree to participate. For example, most surveys are biased toward people who have more free time to answer questions: often housewives, unemployed, retired, or students.

The ratio of the number of people who participate in the survey over to the number who were asked is called the “response rate”. The response rate is an important measure of the quality of the survey. Response rates vary a lot depending on the mode of the survey. Typical response rates for in-home interviews are around 50%; for telephone polls, 10-20%, for Internet surveys 1-4%.

Question wording

Finally, there are errors due to measurement problems. This is a complex subject that will not be covered in detail. One source of measurement problems is badly worded questions. For example, if you want to know how people felt about a training programme don’t ask “Was the training programme useful?,” instead ask “Was the training useful or not useful?” because you don’t want to emphasize one answer or the other. You want to offer options that represent the basic choice: useful or not useful; approval or disapproval. Sometimes it could be a range, like “How confident are you that you will use the training?” You can be extremely confident, you can be not confident at all, or you can be somewhere in the middle. Second, consider the question: “Do you want to see less money spent on defence and more on the NHS?” The problem is that regardless of whether a respondent agrees or disagrees it is not clear what they are agreeing/disagreeing to. They may want to spend more on the NHS but that doesn’t mean that they want less spent on defense, and vice versa. These are called “double-barreled questions” because they are really two separate questions. Another example of a bad question is: “Do you favor killing unborn babies?” This sort of question is loaded with emotional or red flag words that make it very hard to disagree with, regardless of the respondent’s true feelings about abortion. None of these types of questions will produce accurate answers.

Finally, questions need to be understood by everybody who is answering the survey. They need to be understood by people who have a Ph.D. and people who have no educational qualifications. Good questions:

- Are concise, short, simple and avoid jargon
- Are easily understood by all respondents
- Don't presume information
- Don't tax a respondent's memory or cognitive ability
- Use balanced, neutral wording to avoid bias
- Ask about only one thing
- Avoid negative terms like "not", "none" or "no"

Question wording matters a lot. It is important to provide the complete text of questions and responses so that readers can judge for themselves whether you have avoided these problems. The questions we provide to measure digital engagement have been professional written to avoid these and other problems. It is very important that you keep the exact wording and do not change a single word. This ensures that your results are comparable to other surveys using the same questions.

Question order

The context of the questions matters a lot. This is an issue of questionnaire design and format. Several suggestions for the questionnaire are:

- Start with simple and interesting questions. You want to grab respondents at the beginning with something that they know and enjoy thinking about. Possibly pleasurable, enjoyable experiences online.
- After several warm up questions, ask the most important questions in the survey. This is the place where respondents are least likely to be affected by respondent fatigue.
- End with sensitive questions like age, qualifications, marital status, gender, employment status, and ethnicity. In many countries, income is among these questions, but the British people are very sensitive to talking about their income so you may want to omit it. If you do include it be prepared for a high rate of non-response.
- Include the date and time when the survey was distributed as well as a respondent ID number. To help protect confidentiality the respondent's name should not appear on the questionnaire.

Pay attention to the order of the questions. People respond to questions by telling you about what is on top of their heads. Consider the following sequence of four questions:

1. How important is the NHS to you?
2. Are you worried about possible privatization of part of the NHS?
3. Do you think that high quality NHS care will be available to you when you need it?
4. What is the most important problem facing the United Kingdom?

The first three questions will prompt people to think about the NHS. These questions push the NHS to the top of their minds. When respondents reach the fourth question and need to retrieve from their minds the most important problem facing Britain, the NHS will be easy to retrieve. A much higher proportion of people would say the NHS is an important problem than they would if the question about the most important problem had been placed first instead of last. The point is that the answers are influenced by preceding questions. If you want accurate, unbiased results you need to be careful about question order.

Instructions for respondents

You need a cover letter, email or instruction sheet for any survey. There are usually four important pieces of information to include in the instructions.

1. The purpose of the survey. This is very important. The more respondents see the survey as personally important to them, the more likely they are to complete it.
2. Who is sponsoring the survey and who is administering it.
3. How confidentiality will be protected. A strong assurance of anonymity is an important way to increase the likelihood of honest responses.
4. Who the respondent can call, write or email if they have questions, concerns, or want a copy of the survey results.

If possible, the instructions, email or cover letter should be personalized with the respondent's name. This will improve your response rate.

Response rates

Response rates to survey vary enormously. There are a number of actions that you can take to improve response rates.

Salience refers to the significance or value of a topic to the respondent. Salient questionnaires receive much higher response rates than non-salient surveys. Your cover letter should always explain how the respondent will benefit personally from completing the questionnaire. One approach is for the cover letter to be signed by a person who the respondent knows, either personally, by reputation or by affiliation (like a CEO), a politician, or another well-known person. Salience is usually the single most important factor in improving your response rate. Public health surveys can achieve response rates of over 80%. Marketing surveys often get 20%

Follow-up contacts. When potential respondents don’t respond to your initial contact, what is the effect of follow-up contacts? The first follow-up adds about 15-20% more respondents; the second follow-up adds another 10-15%; the third follow-up adds perhaps 5%. The fourth and later follow-ups seem to add little.

Reachable population. If the population is easily reachable, for example, students, employees or clients, they are more likely to return the questionnaire than if the survey is of the general population.

Adding a **monetary incentive** increases the response rate. Typical incentives include £5 or £10 or inclusion in a drawing for a prize.

Advance contact, such as sending a letter or an email telling respondents that the questionnaire is coming, seems to have about the same effect as follow-up.

Length does not seem to have a big effect. It only appears when salience and follow-up are controlled. Obviously at some point length matters, but not for moderately long questionnaires of 10-20 minutes.

Pretesting your questionnaire

By the time you have written the questionnaire you may be too close to it to see potential problems. You may want to ask several people to critique it before you pretest it.

Pretesting is important because you may find that your understanding of the questions differs from that of potential respondents. To pretest, choose a small sample of people who are similar to the people you will be surveying. You may want to include people with different qualifications or different income, with or without children, different ages, different marital status, depending on what factors you think will affect a respondent's ability and willingness to complete the survey. If possible time how long the pretesters need to complete the survey. Encourage pretest respondents to make comments on each question, as well as on the order and format of the questions. This is often best done by interviewing them immediately after they complete the questionnaire. If several people complete the survey at once, then discussing it in a small group may be helpful.

Pay close attention to any questions that pretesters refuse to answer, misunderstand or answer incorrectly. These questions may be poorly worded, too difficult to answer, or too sensitive to answer. These questions should be revised, and pretested again, if possible.

Administering the survey

There are usually seasonal differences in availability of willing respondents. You want to avoid times like August and December because they will produce higher non-response rates. School term breaks may also be bad times if your population includes large numbers of households with children.

If you are conducting the survey yourself, there are several administrative issues to consider. Keep lists of all people contacted for the survey (including addresses, email addresses, and phone numbers) and when they completed the survey. For respondents who refuse to complete the survey, try to learn why and record the reasons. This may help you understand ways you can modify your data collection methods. Keep track of any additional contacts, like follow up phone calls or emails. Make sure that all personally identifiable information like names and addresses are kept strictly confidential. Tabulate the number of people contacted and the number who actually completed the survey so you can calculate a response rate. This is an important number that you should report whenever you report any results from the survey.

Checking your data

Once you have data, the first step is to check it for errors. For example if the possible codes for gender are 0 = Male and 1 = Female, then be sure that you don’t have any 3s or 4s. This is a check for impossible codes. You need to do this check for every single question in your questionnaire. A related check is for unusually large or small values, for example a respondent who claims to spend over 100 hours per week on the Internet. You need to decide what to do when you encounter implausible values like this. There are many possibilities. Some respondents may have special characteristics that make an unusually large or small number plausible, or they may have misunderstood the question, or this may be evidence they are not taking your survey seriously. You should check to see if this is a data entry error that you can fix. If this occurs in a small number of instances you may want to remove it from the dataset. If you remove data, you need to report it in the methodological section of the results. You may also want to report the data with and without these cases.

You will need special codes for non-response. There are many kinds of non-responses, such as people who were never asked certain questions. For example, in a survey of Internet use, people who don’t use social media would not be asked social media questions. People who don’t own smartphones would not be asked smartphone questions. Households without children would not be asked questions about their children’s Internet use. Because these questions were skipped they are called “legitimate skips”. They could be coded -1. Also, some people will refuse to answer certain questions. In Britain questions about income have high rates of refusal. Refusals can be coded as -2. Some people may be asked questions but they don’t know the answers. People who respond “don’t know” can be coded as -3.

Weights

If your survey is for a local project you don’t need to use weights and you don’t need to read this. However, all national surveys need to be weighted. Weighting corrects for the problem of not including groups in the sample in the correct proportion to their size in the population. This is called “post-stratification” weighting. It is one way to correct for sampling error and non-response error. The table below contains a simple example:

Qualifications	Population %	Sample %	Weight
No qualifications	10	5	2.0
GCSE	25	10	2.5
Further education	35	35	1.0
University graduate	30	50	0.6

The second column in the table shows the percent of the population who have four educational qualifications. The third column shows hypothetical survey results. The survey received responses from too few people with no qualifications or GCSEs and too many university graduates. We can correct for this by weighting each respondent. Respondents who report no qualifications receive a weight of 2.0. Respondents reporting GCSEs will be weighted 2.5. Further education respondents will be weighted 1.0 and university graduates will be given a weight of 0.6.

The software you use to analyze the survey has to be able to use weights correctly. Any standard statistical software will be able to handle weights. Look in the documentation or help files for “weights” or “post-stratification weights” or “probability weights”. Spreadsheets like Excel and most database software will not handle weights and this is a good reason to avoid them for statistical analysis.

What the software will do is count the respondent in the results in proportion to the weight. Thus a person with no qualifications and a weight of 2.0 will be counted twice as heavily in the results compared to a person who has further education and a weight of 1.0. The value of weighting is that it adjusts the results from the sample so that they more closely reflect the results from the population as a whole.

Weights have an important limit that you should know. You can only weight to *known* population values. In national samples this usually means the population values reported by the British census. Although the census collects data on everyone, it does not collect very much data. Weights will probably be limited to gender, age, region, urban-rural status and a few others.

Analysis

Once you have collected your data they have to be analyzed. Analysis of survey data is a very large topic. I will just touch on a few central issues; for further information, see the suggested readings at the end.

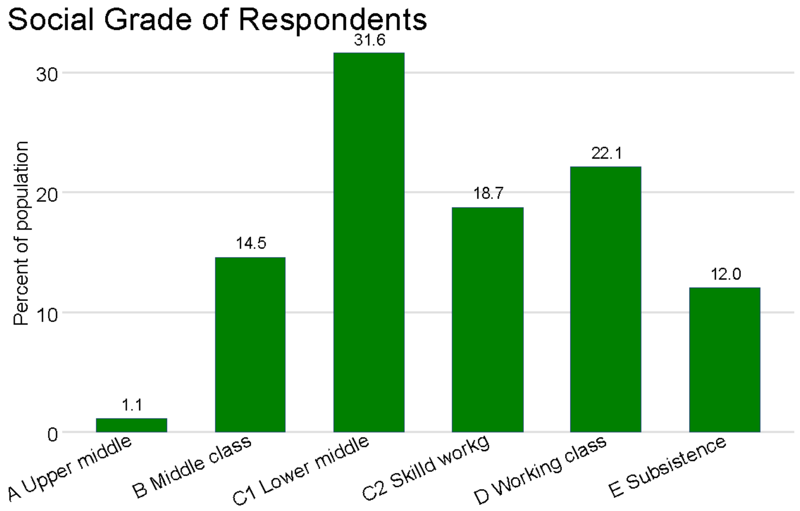
The oldest and still most common method of analysis is percentage tables. They remain an excellent technique for gaining insights into your data. You are unlikely to need anything more sophisticated. Simple frequency tables are an excellent way to describe your data. Below is a frequency table of the social grade of respondents from the 2013 wave of the Oxford Internet Survey:

Social Grade of Respondents

		Frequency	Percent	Valid %
Valid	A Upper middle	25	0.9	1.1
	B Middle class	332	12.5	14.6
	C1 Lower middle	720	27.1	31.6
	C2 Skilled working	427	16.1	18.7
	D Working class	504	19.0	22.9
	E Subsistence	274	20.3	12.0
	Total valid	2,282	85.9	100
Missing	Legitimate skip	365	13.7	
	Refused	10	0.4	
	Total	375	14.1	
Total		2,657	100	

The table has three columns of data: the frequency in each category, the percent in each category and the valid percent in each category. Looking first at the column titled “Frequency”, the bottom row, labelled “Total” shows that there were 2,657 respondents in the survey, but the “Total valid” rows indicates that only 2,282 have valid data on social grade. Among the 375 missing, 365 were missing because they were not asked (social grade is based, in part, on occupation, so these would be students, unemployed or retired) and 10 refused to give the information. The “percent” column contains percents of all respondents, regardless of whether they have data on social grade. The “valid %” column contains percents of only those cases where there are valid responses. In general, the valid % column is the one you want to pay attention to. You can see in the first row of the table that 25 respondents, or 1.1%, were in social grade A, compared to 274 respondents, or 12.0%, in social grade E.

The graph below shows the same percentage table in a more visual form. This form is probably better for presentation to most audiences.



Two-way percentage tables tell you how different variables are related to each other. For example, to show how social grade is related to Internet use, we cross-tabulate social grade and Internet use. We put social grade in the rows and Internet use in the columns and ask for row percents. The result is below:

Social Grade by Internet Use

	Non- user	User	Total	Frequenc y
A Upper middle	0.0%	100.0	100	21
B Middle class	6.3	93.8	100	314
C1 Lower middle	12.6	87	100	676
C2 Skilled working	28.7	71.4	100	465
D Working class	30.8	69.2	100	478
E Subsistence	51.8	48.2	100	239
Total	23.2	76.8	100	2,195

For each category of social grade the table contains four data columns. The first data column is the percentage of non-Internet users in that social grade. The second column is the percentage of Internet users in that social grade. These two columns add to 100%, which is the third column. The final column on the right gives the number of respondents in each row. Analysis consists of comparing the percentages down the columns. For example, looking at the percentage of users, we notice that 100% of social grade A are Internet users. As we go down the list of social grades the percentage of Internet users declines steadily. At the lowest level, only 48.2% of the people social grade E are Internet users. From this analysis we would conclude that social grade has a major impact on Internet use. You could do the same analysis of the non-user column, but since the percent non-users plus the percent users adds up to 100% an analysis of non-users would just be a mirror image of the analysis we just did on users.

Since we are looking at the influence of social grade on Internet use, we are thinking of social grade as a causal variable. It causes (some of the) variation in Internet use. We say that the proportion of Internet users depends (in part) on social grade. When we think about causes and effects in this way we have a simple rule for setting up a two-way table: Ask for percentages in the direction of the causal variable. If the causal variable is in the rows, calculate row percents. Then do your comparisons down the columns, like we did in the previous paragraph. This rule can be stated concisely: For a two-way table, calculate percentages in the direction of the causal variable and compare in the other direction.

Reporting your methodology

There are minimum standards for reporting the methodology you use in your survey. Reporting this information allows readers to judge the quality of your work. This information can be on a web page and it should be included as a "Methodological Appendix" in any report. The minimum standard information is:

- Name of the survey sponsor
- Name of the organization that conducted the survey
- The exact wording of the questions being analyzed and the possible responses
- The definition of the population under study.
- A description of the sampling frame used to represent the population under study
- An explanation of how respondents were selected
- Total number of potential respondents contacted, total completed surveys returned and the response rate.
- The mode of data collection; e.g. paper, telephone, Internet-based, email, etc.
- The dates and location(s) of data collection

- Estimates of sampling error
- A description of the weighting procedure (if used)

For additional information

Many books have been written about the conduct and analysis of surveys. Textbooks are most accessible for a novice. Two good choices are:

Babbie, Earl. (2010) *The practice of social research*. 12th ed. Wadsworth. This has excellent chapters on sampling, writing questions, and analysis of surveys.

De Vaus, David. (2014) *Surveys in social research*. 6th ed. Routledge. Has excellent chapters on all phases of the survey process.