CHAPTER 14

Stage 1
Problem definition

Stage 2
Research approach developed

Stage 3
Research design developed

Stage 4
Fieldwork or data collection

Stage 5
Data preparation and analysis

Stage 6
Report preparation and presentation

Sampling: design and procedures

Objectives

After reading this chapter, you should be able to:

1 differentiate a sample from a census and identify the conditions that favour the use of a sample versus a census;

2 discuss the sampling design process: definition of the target population, determination of the sampling frame, selection of sampling technique(s), determination of sample size, execution of the sampling process and validating the sample;

3 classify sampling techniques as non-probability and probability sampling techniques;

4 describe the non-probability sampling techniques of convenience, judgemental, quota and snowball sampling;

5 describe the probability sampling techniques of simple random, systematic, stratified and cluster sampling;

6 identify the conditions that favour the use of non-probability sampling versus probability sampling;

7 understand the sampling design process and the use of sampling techniques in international marketing research;

8 identify the ethical issues related to the sampling design process and the use of appropriate sampling techniques.

There is no hope of making scientific statements about a population based on the knowledge obtained from a sample, unless we are circumspect in choosing a sampling method.

Overview

Sampling is a key component of any research design. Sampling design involves several basic questions:

1 Should a sample be taken?
2 If so, what process should be followed?
3 What kind of sample should be taken?
4 How large should it be?
5 What can be done to control and adjust for non-response errors?

This chapter introduces the fundamental concepts of sampling and the qualitative considerations necessary to answer these questions. We address the question of whether or not to sample and describe the steps involved in sampling. Next, we present non-probability and probability sampling techniques. We discuss the use of sampling techniques in international marketing research and identify the relevant ethical issues. Statistical determination of sample size, and the causes for, control of and adjustments for non-response error are discussed in Chapter 15.

We begin with the following example, which illustrates the usefulness of sampling.

example

Can football give brands 110% recall?[1]

The European Football Championship held in England in 1996 proved that football is the world's number one sport. More than 1.3 million tickets were sold and 250,000 overseas visitors followed their teams to England. The 31 matches were watched in more than 190 countries around the world by a global cumulative television audience of 6.7 billion; 445 million tuned in to watch the final itself.

Commercial support for the event came from a group of 11 official sponsors: Canon, Carlsberg, Coca-Cola, Fuji Film, General Motors, JVC, McDonald's, MasterCard, Philips, Snickers and Umbro. Such a weight of marketing activity represented a major investment for the sponsors and it was vital that they were able to evaluate its effectiveness. Many individual sponsors conducted their own studies, but a study was conducted for the sponsor group to evaluate the impact of EURO 96 as a sponsorship opportunity.

The survey to evaluate sponsorship effectiveness was a two-wave study, the first taking place eight months prior to the tournament, the second immediately after the final. The research was carried out in four countries, the national football teams of each one having successfully qualified for the finals, thus ensuring a consistent level of interest in the tournament across the sample:

UK: Host nation
France: Host to the 98 World Cup
Germany: Tournament favourites
Russia: East European nation

In each market a sample of 500 individuals aged 12 to 65 was interviewed at each wave, quota controls being imposed on sex, age and socio-economic group to match the incidence of each within the general population. ■

This example illustrates the various aspects of sampling design, clearly founded in a marketing and research problem. The target population is defined, the sampling technique is established with criteria for quotas, and the sample size for each country and survey wave is set.

Imagine if the researchers in the above example had attempted to survey every viewer, i.e. to conduct a census. The cost involved and the time needed to complete the task would have been astronomical. Even if the sponsors could afford to undertake a census, would it give them a more accurate view of the television audience? In certain circumstances administering a survey to the whole of a target makes sense; to an audience of 6.7 billion it does not.

Sample or census

Population
The aggregate of all the elements, sharing some common set of characteristics, that comprise the universe for the purpose of the marketing research problem.

Census
A complete enumeration of the elements of a population or study objects.

Sample
A subgroup of the elements of the population selected for participation in the study.

The objective of most marketing research projects is to obtain information about the characteristics or parameters of a **population**. A population is the aggregate of all the elements that share some common set of characteristics and that comprise the universe for the purpose of the marketing research problem. The population parameters are typically numbers, such as the proportion of consumers who are loyal to a particular brand of toothpaste. Information about population parameters may be obtained by taking a **census** or a **sample**. A census involves a complete enumeration of the elements of a population. The population parameters can be calculated directly in a straightforward way after the census is enumerated. A sample, on the other hand, is a subgroup of the population selected for participation in the study. Sample characteristics, called statistics, are then used to make inferences about the population parameters. The inferences that link sample characteristics and population parameters are estimation procedures and tests of hypotheses. These inference procedures are considered in Chapters 18 to 24.

Table 14.1 Sample versus census

Factors	*Conditions favouring the use of*	
	Sample	*Census*
1 Budget	Small	Large
2 Time available	Short	Long
3 Population size	Large	Small
4 Variance in the characteristic	Small	Large
5 Cost of sampling errors	Low	High
6 Cost of non-sampling errors	High	Low
7 Nature of measurement	Destructive	Non-destructive
8 Attention to individual cases	Yes	No

Table 14.1 summarises the conditions favouring the use of a sample versus a census. Budget and time limits are obvious constraints favouring the use of a sample. A census is both costly and time-consuming to conduct. A census is unrealistic if the population is large, as it is for most consumer products. In the case of many industrial products, however, the population is small, making a census feasible as well as desirable. For example, in investigating the use of certain machine tools by Italian car manufacturers, a census would be preferred to a sample. Another reason for preferring a census in this case is that variance in the characteristic of interest is large. For example, machine tool usage of Fiat may vary greatly from the usage of Ferrari. Small population sizes as well as high variance in the characteristic to be measured favour a census.

If the cost of sampling errors is high (e.g. if the sample omitted a major manufacturer like Ford, the results could be misleading) a census, which eliminates such errors, is desirable. If the cost of non-sampling errors is high (e.g. interviewers incorrectly questioning target respondents) a sample, where fewer resources would have been spent, would be favoured.

A census can greatly increase non-sampling error to the point that these errors exceed the sampling errors of a sample. Non-sampling errors are found to be the major contributor to total error, whereas random sampling errors have been relatively small in magnitude.[2] Hence, in most cases, accuracy considerations would favour a sample over a census.

A sample may be preferred if the measurement process results in the destruction or contamination of the elements sampled. For example, product usage tests result in the consumption of the product. Therefore, taking a census in a study that requires households to use a new brand of photographic film would not be feasible. Sampling may also be necessary to focus attention on individual cases, as in the case of depth interviews. Finally, other pragmatic considerations, such as the need to keep the study secret, may favour a sample over a census.

The sampling design process

The sampling design process includes six steps, which are shown sequentially in Figure 14.1. These steps are closely interrelated and relevant to all aspects of the marketing research project, from problem definition to the presentation of the results. Therefore, sample design decisions should be integrated with all other decisions in a research project.[3]

Define the target population

Target population
The collection of elements or objects that possess the information sought by the researcher and about which inferences are to be made.

Element
An object that possesses the information sought by the researcher and about which inferences are to be made.

Sampling unit
An element, or a unit containing the element, that is available for selection at some stage of the sampling process.

Sampling design begins by specifying the **target population**. This is the collection of elements or objects that possess the information sought by the researcher and about which inferences are to be made. The target population must be defined precisely. Imprecise definition of the target population will result in research that is ineffective at best and misleading at worst. Defining the target population involves translating the problem definition into a precise statement of who should and should not be included in the sample.

The target population should be defined in terms of elements, sampling units, extent and time. An **element** is the object about which or from which the information is desired. In survey research, the element is usually the respondent. A **sampling unit** is an element, or a unit containing the element, that is available for selection at some stage of the sampling process. Suppose that Clinique wanted to assess consumer

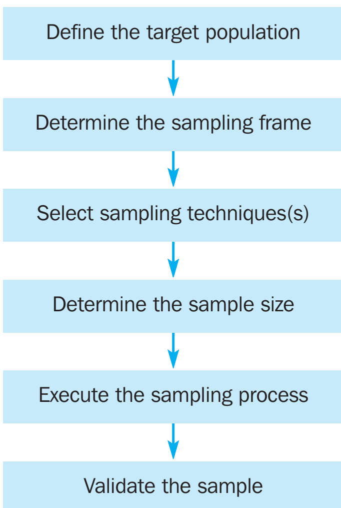

Figure 14.1
The sampling design process

response to a new line of lipsticks and wanted to sample females over 25 years of age. It may be possible to sample females over 25 directly, in which case a sampling unit would be the same as an element. Alternatively, the sampling unit might be households. In the latter case, households would be sampled and all females over 25 in each selected household would be interviewed. Here, the sampling unit and the population element are different. Extent refers to the geographical boundaries of the research, and the time refers to the period under consideration. We use the GlobalCash Project to illustrate.

example
GlobalCash Project

Target population

The target population for the GlobalCash Project was defined as follows:

Elements: managers responsible for cash management decisions
Sampling units: the largest companies and non-banking financial institutions in a country
Extent: 19 European countries plus the centres of taxation concessions in Ireland and Belgium
Time: 2002

Defining the target population may not be as easy as it was in this example. Consider a marketing research project assessing consumer response to a new brand of men's moisturiser. Who should be included in the target population? All men? Men who have used a moisturiser during the last month? Men of 17 years of age or older? Should females be included, because some women buy moisturiser for men whom they know? These and similar questions must be resolved before the target population can be appropriately defined.[4]

Determine the sampling frame

Sampling frame
A representation of the elements of the target population that consists of a list or set of directions for identifying the target population.

A **sampling frame** is a representation of the elements of the target population. It consists of a list or set of directions for identifying the target population. Examples of a sampling frame include the telephone book, an association directory listing the firms in an industry, a customer database, a mailing list on a database purchased from a commercial organisation, a city directory, or a map.[5] If a list cannot be compiled, then at least some directions for identifying the target population should be specified, such as random-digit dialling procedures in telephone surveys.

Often it is possible to compile or obtain a list of population elements, but the list may omit some elements of the population or may include other elements that do not belong. Therefore, the use of a list will lead to sampling frame error, which was discussed in Chapter 3.[6]

In some instances, the discrepancy between the population and the sampling frame is small enough to ignore. In most cases, however, the researcher should recognise and attempt to treat the sampling frame error. The main approach is to redefine the population in terms of the sampling frame. For example, if a telephone directory is used as a sampling frame, the population of households could be redefined as those with a correct listing in a given area. Although this approach is simplistic, it does prevent the researcher from being misled about the actual population being investigated.[7]

Ultimately, the major drawback of redefining the population based upon available sampling frames is that the nature of the research problem may be compromised. Who is being measured and ultimately to whom the research findings may be generalised may not match the target group of individuals identified in a research problem definition. Evaluating the accuracy of sampling frames matches the issues of evaluating the quality of secondary data (see Chapter 4).

Select a sampling technique

Selecting a sampling technique involves several decisions of a broader nature. The researcher must decide whether to use a Bayesian or traditional sampling approach, to sample with or without replacement, and to use non-probability or probability sampling.

Bayesian approach
A selection method where the elements are selected sequentially. The Bayesian approach explicitly incorporates prior information about population parameters as well as the costs and probabilities associated with making wrong decisions.

In the **Bayesian approach**, the elements are selected sequentially. After each element is added to the sample, the data are collected, sample statistics computed and sampling costs determined. The Bayesian approach explicitly incorporates prior information about population parameters as well as the costs and probabilities associated with making wrong decisions. This approach is theoretically appealing. Yet it is not used widely in marketing research because much of the required information on costs and probabilities is not available. In the traditional sampling approach, the entire sample is selected before data collection begins. Because the traditional approach is the most common approach used, it is assumed in the following sections.

Sampling with replacement
A sampling technique in which an element can be included in the sample more than once.

Sampling without replacement
A sampling technique in which an element cannot be included in the sample more than once.

In **sampling with replacement**, an element is selected from the sampling frame and appropriate data are obtained. Then the element is placed back in the sampling frame. As a result, it is possible for an element to be included in the sample more than once. In **sampling without replacement**, once an element is selected for inclusion in the sample, it is removed from the sampling frame and therefore cannot be selected again. The calculation of statistics is done somewhat differently for the two approaches, but statistical inference is not very different if the sampling frame is large relative to the ultimate sample size. Thus, the distinction is important only when the sampling frame is small compared with the sample size.

The most important decision about the choice of sampling technique is whether to use non-probability or probability sampling. Non-probability sampling relies on the judgement of the researcher, while probability sampling relies on chance. Given its importance, the issues involved in this decision are discussed in detail below, in the section headed 'A classification of sampling techniques'.

If the sampling unit is different from the element, it is necessary to specify precisely how the elements within the sampling unit should be selected. With in-home personal interviews and telephone interviews, merely specifying the address or the telephone number may not be sufficient. For example, should the person answering the doorbell or the telephone be interviewed, or someone else in the household? Often, more than one person in a household may qualify. For example, both the male and female head of household, or even their children, may be eligible to participate in a study examining family leisure-time activities. When a probability sampling technique is being employed, a random selection must be made from all the eligible persons in each household. A simple procedure for random selection is the 'next birthday' method. The interviewer asks which of the eligible persons in the household has the next birthday and includes that person in the sample.

Determine the sample size

Sample size
The number of elements to be included in a study.

Sample size refers to the number of elements to be included in the study. Determining the sample size involves several qualitative and quantitative considerations. The qualitative factors are discussed in this section, and the quantitative factors are considered in Chapter 15. Important qualitative factors to be considered in determining the sample size include (1) the importance of the decision, (2) the nature of the research, (3) the number of variables, (4) the nature of the analysis, (5) sample sizes used in similar studies, (6) incidence rates, (7) completion rates, and (8) resource constraints.

In general, for more important decisions, more information is necessary, and that information should be obtained very precisely. This calls for larger samples, but as the sample size increases, each unit of information is obtained at greater cost. The degree of precision may be measured in terms of the standard deviation of the mean, which is inversely proportional to the square root of the sample size. The larger the sample, the smaller the gain in precision by increasing the sample size by one unit.

The nature of the research also has an impact on the sample size. For exploratory research designs, such as those using qualitative research, the sample size is typically small. For conclusive research, such as descriptive surveys, larger samples are required. Likewise, if data are being collected on a large number of variables, i.e. many questions are asked in a survey, larger samples are required. The cumulative effects of sampling error across variables are reduced in a large sample.

If sophisticated analysis of the data using multivariate techniques is required, the sample size should be large. The same applies if the data are to be analysed in great detail. Thus, a larger sample would be required if the data are being analysed at the subgroup or segment level than if the analysis is limited to the aggregate or total sample.

Sample size is influenced by the average size of samples in similar studies. Table 14.2 gives an idea of sample sizes used in different marketing research studies. These sample sizes have been determined based on experience and can serve as rough guidelines, particularly when non-probability sampling techniques are used.

Table 14.2 Usual sample sizes used in marketing research studies

Type of study	*Minimum size*	*Typical range*
Problem identification research (e.g. market potential)	500	1000–2500
Problem-solving research (e.g. pricing)	200	300–500
Product tests	200	300–500
Test marketing studies	200	300–500
TV, radio or print advertising (per commercial/ad tested)	150	200–300
Test-market audits	10 stores	10–20 stores
Focus groups	2 groups	4–12 groups

➤➤➤ *See Professional Perspective 12.*

The sample size required should be adjusted for the incidence of eligible respondents and the completion rate (see Professional Perspective 12 by Pat Dowding on the Companion Website for a fuller discussion and statistics to support these points). Finally, the sample size decision should be guided by a consideration of the resource constraints. In any marketing research project, money and time are limited. The decisions involved in determining the sample size are covered in detail in the next chapter.

Execute the sampling process

Execution of the sampling process requires a detailed specification of how the sampling design decisions with respect to the population, sampling unit, sampling frame, sampling technique and sample size are to be implemented. Whilst an individual researcher may know how they are going to execute their sampling process, once more than one individual is involved, a specification for execution is needed to ensure that the process is conducted in a consistent manner. For example, if households are the sampling unit, an operational definition of a household is needed. Procedures should be specified for empty housing units and for call-backs in case no one is at home.

Validate the sample

Sample validation aims to account for sampling frame error by screening the respondents in the data collection phase. Respondents can be screened with respect to demographic characteristics, familiarity, product usage and other characteristics to ensure that they satisfy the criteria for the target population. Screening can eliminate inappropriate elements contained in the sampling frame, but it cannot account for elements that have been omitted. The success of the validation process depends upon the accuracy of base statistics that describe the structure of a target population.

Once data are collected from a sample, comparisons between the structure of the sample and the target population should be made. Once data have been collected and it is found that the structure of a sample does not match the target population, a weighting scheme can be used (this is discussed in Chapter 17).

The steps involved in the sampling design process are illustrated in the following example based upon a continuous tracking survey.

example

Taking the people's temperature – right across Europe[8]

Since the earliest days of the European Economic Community, the Commission's information, communication, culture and audio-visual directorate, Directorate General X, has conducted regular polls across Europe. In 1996 the need for speed and flexibility in EU surveys led to the introduction of the Continuous Tracking Survey or CTS. The origin of the CTS was a policy initiative on information and communication, established in 1993 as a result of the decline in support for the EU in the period leading up to the Single Market and the ratification of the Maastricht Treaty.

The sample design for this study involved:

1 *Target population*: adults aged 18 years and over (element) in a household with a working telephone number (sampling unit) in individual EU countries (extent) during the survey period (time).
2 *Sampling frame*: computer program for generating random digit dialling (except in Germany where the code of practice forbids this approach).
3 *Sampling unit*: working telephone numbers.
4 *Sampling technique*: random sampling.
5 *Sample size*: 800 in each of 16 sampling areas making a total of 12,800 interviews in each four-week wave of interviewing – a total of 140,000 interviews each year.
6 *Execution*: CATI, random digit dialling followed by the random selection of individuals in households. 19 variants of the questionnaire to include people living in countries where more than one national language is common.
7 *Validation*: Sample characteristics compared with census statistics in each country.

A classification of sampling techniques

Sampling techniques may be broadly classified as non-probability and probability (see Figure 14.2).

Non-probability sampling
Sampling techniques that do not use chance selection procedures but rather rely on the personal judgement of the researcher.

Non-probability sampling relies on the personal judgement of the researcher rather than on chance to select sample elements. The researcher can arbitrarily or consciously decide what elements to include in the sample. Non-probability samples may yield good estimates of the population characteristics, but they do not allow for objective evaluation of the precision of the sample results. Because there is no way of determining the probability of selecting any particular element for inclusion in the sample, the estimates obtained are not statistically projectable to the population. Commonly used non-probability sampling techniques include convenience sampling, judgemental sampling, quota sampling and snowball sampling.

Probability sampling
A sampling procedure in which each element of the population has a fixed probabilistic chance of being selected for the sample.

In **probability sampling**, sampling units are selected by chance. It is possible to pre-specify every potential sample of a given size that could be drawn from the population, as well as the probability of selecting each sample. Every potential sample need not have the same probability of selection, but it is possible to specify the probability

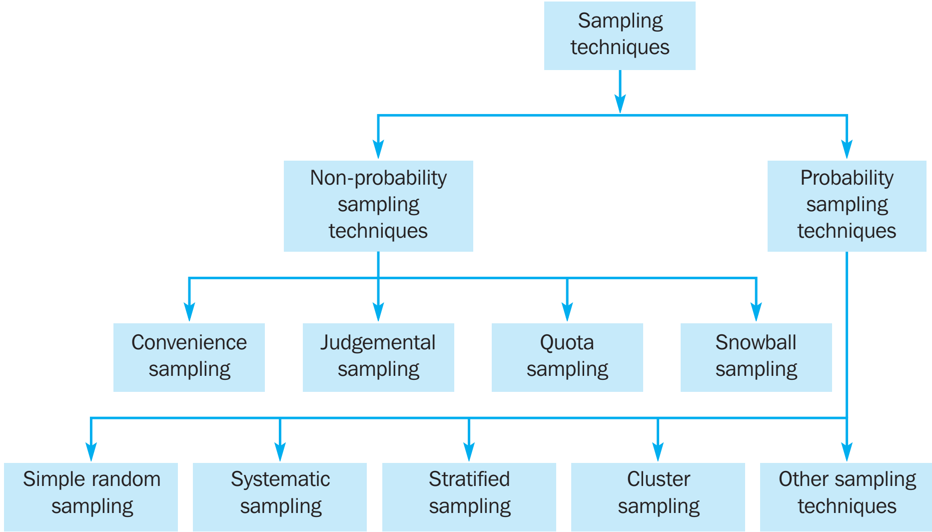

Figure 14.2 A classification of sampling techniques

of selecting any particular sample of a given size. This requires not only a precise definition of the target population but also a general specification of the sampling frame. Because sample elements are selected by chance, it is possible to determine the precision of the sample estimates of the characteristics of interest. **Confidence intervals**, which contain the true population value with a given level of certainty, can be calculated. This permits the researcher to make inferences or projections about the target population from which the sample was drawn. Classification of probability sampling techniques is based on:

Confidence intervals
The range into which the true population parameter will fall, assuming a given level of confidence.

- Element versus cluster sampling
- Equal unit probability versus unequal unit probability
- Unstratified versus stratified selection
- Random versus systematic selection
- One-stage versus multistage techniques.

All possible combinations of these five aspects result in 32 different probability sampling techniques. Of these techniques, we consider simple random sampling, systematic sampling, stratified sampling and cluster sampling in depth and briefly touch on some others. First, however, we discuss non-probability sampling techniques.

Non-probability sampling techniques

Convenience sampling

Convenience sampling
A non-probability sampling technique that attempts to obtain a sample of convenient elements. The selection of sampling units is left primarily to the interviewer.

Convenience sampling attempts to obtain a sample of convenient elements. The selection of sampling units is left primarily to the interviewer. Often, respondents are selected because they happen to be in the right place at the right time. Examples of convenience sampling include: (1) use of students, church groups and members of social organisations, (2) street interviews without qualifying the respondents, (3) some forms of email and Internet survey, (4) tear-out questionnaires included in a newspaper or magazine, and (5) journalists interviewing 'people on the street'.[9]

Convenience sampling is the least expensive and least time-consuming of all sampling techniques. The sampling units are accessible, easy to measure and cooperative. Despite these advantages, this form of sampling has serious limitations. Many potential sources of selection bias are present, including respondent self-selection.

Convenience samples are not representative of any definable population. Hence, it is not theoretically meaningful to generalise to any population from a convenience sample, and convenience samples are not appropriate for marketing research projects involving population inferences. Convenience samples are not recommended for descriptive or causal research, but they can be used in exploratory research for generating ideas, insights or hypotheses. Convenience samples can be used for pre-testing questionnaires, or pilot studies. Even in these cases, caution should be exercised in interpreting the results.

Judgemental sampling

Judgemental sampling
A form of convenience sampling in which the population elements are purposely selected based on the judgement of the researcher.

Judgemental sampling is a form of convenience sampling in which the population elements are selected based on the judgement of the researcher. The researcher, exercising judgement or expertise, chooses the elements to be included in the sample because he or she believes that they are representative of the population of interest or are otherwise appropriate. Common examples of judgemental sampling include: (1) test markets selected to determine the potential of a new product, (2) purchase engineers selected in industrial marketing research because they are considered to be representative of the company, (3) product testing with individuals who may be particularly fussy or who hold extremely high expectations, (4) expert witnesses used in court, and (5) supermarkets selected to test a new merchandising display system. The use of this technique is illustrated in the context of the GlobalCash Project.

example
GlobalCash Project

Judgemental sampling

In the GlobalCash study, at least two cash managers in every country surveyed were selected for an additional interview. The selection of these managers was based on the judgement of members of the research team. Many of the companies and indeed cash manager respondents were known to the research team. If the individual manager was not known, characteristics of the respondent organisations were known. The purpose of the interviews was to explore the reasons behind why cash managers carry out specific activities or plan certain events. To be able to fulfil this purpose managers were needed who:

- were willing to give up at least two hours to discuss issues
- were able to articulate the reasons for their behaviour
- were ‘sophisticated’ in their approach to cash management
- had a wide array of experience of pan-European banks.

Perhaps the most subjective element of this list is the issue of ‘sophistication’. This does not necessarily mean the most technically complex or the use of state-of-the-art technology, but the use of creative solutions to cash management problems. In this example, judgement was used to select specific managers who met the above criteria. ■

Judgemental sampling is inexpensive, convenient and quick, yet it does not allow direct generalisations to a specific population, usually because the population is not defined explicitly. Judgemental sampling is subjective and its value depends entirely on the researcher’s judgement, expertise and creativity. It can be useful if broad population inferences are not required. As in the GlobalCash example, judgement samples are frequently used in business-to-business marketing research projects.

Quota sampling

Quota sampling
A non-probability sampling technique that is a two-stage restricted judgemental sampling. The first stage consists of developing control categories or quotas of population elements. In the second stage, sample elements are selected based on convenience or judgement.

Quota sampling may be viewed as two-stage restricted judgemental sampling that is used extensively in street interviewing. The first stage consists of developing control characteristics, or quotas, of population elements such as age or gender. To develop these quotas, the researcher lists relevant control characteristics and determines the distribution of these characteristics in the target population, such as Males 49%, Females 51% (resulting in 490 men and 510 women being selected in a sample of 1,000 respondents). Often, the quotas are assigned so that the proportion of the sample elements possessing the control characteristics is the same as the proportion of population elements with these characteristics. In other words, the quotas ensure that the composition of the sample is the same as the composition of the population with respect to the characteristics of interest.

In the second stage, sample elements are selected based on convenience or judgement. Once the quotas have been assigned, there is considerable freedom in selecting the elements to be included in the sample. The only requirement is that the elements selected fit the control characteristics. This technique is illustrated with the following example.

example

How is epilepsy perceived?

A study was undertaken by the Scottish Epilepsy Association to determine the perceptions of the condition of epilepsy by the adult population in the city of Glasgow. A quota sample of 500 adults was selected. The control characteristics were gender, age and propensity to donate to a charity. Based on the composition of the adult population of the city, the quotas assigned were as follows:

		Male		Female		Totals
		48%		*52%*		
Propensity to donate		*Have a flag*	*No flag*	*Have a flag*	*No flag*	
Age		*50%*	*50%*	*50%*	*50%*	
18 to 30	25%	30	30	33	32	**125**
31 to 45	40%	48	48	52	52	**200**
46 to 60	15%	18	18	19	20	**75**
Over 60	20%	24	24	26	26	**100**
Totals		**120**	**120**	**130**	**130**	
Totals		**240**		**260**		**500**

Note that the percentages of gender and age within the target population can be taken from local census statistics. The percentages of 'propensity to donate' could not be gleaned from secondary data sources and so were split on a 50/50 basis. The interviews were conducted on a Saturday when it was customary to see charity 'flag sellers' operating. One of the hypotheses to be tested in the study was the extent to which those who donated to charities on flag days were more aware of the condition of epilepsy and how to treat epileptic sufferers. Thus the instruction to interviewers was to split interviews between those who wore the 'flag' that they had bought from a street collector and those who had not bought a flag. It was recognised that this was a crude measure of propensity to donate to a charity but was the only tangible clue that could be consistently observed. ■

In this example, quotas were assigned such that the composition of the sample mirrored the population. In certain situations, however, it is desirable to either under- or over-sample elements with certain characteristics. To illustrate, it may be desirable to over-sample heavy users of a product so that their behaviour can be examined in detail. Although this type of sample is not representative, it may nevertheless be very relevant to allow a particular group of individuals to be broken down into subcategories and analysed in depth.

Even if the sample composition mirrors that of the population with respect to the control characteristics, there is no assurance that the sample is representative. If a characteristic that is relevant to the problem is overlooked, the quota sample will not be representative. Relevant control characteristics are often omitted because there are practical difficulties associated with including certain control characteristics. For example, suppose a sample was sought that was representative of the different strata of socio-economic classes in a population. Imagine street interviewers approaching potential respondents who they believe would fit into the quota they have been set. Could an interviewer 'guess' which potential respondents fit into different classes in the same way that they may guess the gender and age of respondents? The initial questions of a street interview could establish characteristics of potential respondents to see whether they fit a set quota. But given the levels of non-response and ineligibility levels found by such an approach, this is not an ideal solution.

Because the elements within each quota are selected based on convenience or judgement, many sources of selection bias are potentially present. The interviewers may go to selected areas where eligible respondents are more likely to be found. Likewise, they may avoid people who look unfriendly or are not well dressed or those who live in undesirable locations. Quota sampling does not permit assessment of sampling error.[10]

Quota sampling attempts to obtain representative samples at a relatively low cost. Its advantages are the lower costs and greater convenience to the interviewers in selecting elements for each quota. Under certain conditions, quota sampling obtains results close to those for conventional probability sampling. [11]

Snowball sampling

Snowball sampling
A non-probability sampling technique in which an initial group of respondents is selected randomly. Subsequent respondents are selected based on the referrals or information provided by the initial respondents. By obtaining referrals from referrals, this process may be carried out in waves.

In **snowball sampling**, an initial group of respondents is selected, sometimes on a random basis, but more typically targeted at a few individuals who are known to possess the desired characteristics of the target population. After being interviewed, these respondents are asked to identify others who also belong to the target population of interest. Subsequent respondents are selected based on the referrals. By obtaining referrals from referrals, this process may be carried out in waves, thus leading to a snowballing effect. Even though probability sampling can be used to select the initial respondents, the final sample is a non-probability sample. The referrals will have demographic and psychographic characteristics more similar to the persons referring them than would occur by chance.[12]

The main objective of snowball sampling is to estimate characteristics that are rare in the wider population. Examples include users of particular government or social services, such as food stamps, whose names cannot be revealed; special census groups, such as widowed males under 35; and members of a scattered minority ethnic group. Another example is research in industrial buyer–seller relationships, using initial contacts to identify buyer–seller pairs and then subsequent 'snowballed' pairs. The major advantage of snowball sampling is that it substantially increases the likelihood of locating the desired characteristic in the population. It also results in relatively low sampling variance and costs.[13] Snowball sampling is illustrated by the following example.

example

Sampling horse owners

Dalgety Animal Feeds wished to question horse owners about the care and feeding of their horses. They could not locate any sampling frame that listed all horse owners, with the exception of registers of major racing stables. However, they wished to contact owners who had one or two horses as they believed this group was not well understood and held great marketing potential. Their initial approach involved locating interviewers at horse feed outlets. The interviewers ascertained basic characteristics of horse owners but more importantly they invited them along to focus groups. When the focus groups were conducted, issues of horse care

Snowball sampling – to help target respondents who do not usually display their unique characteristics so clearly.

and feeding were developed in greater detail to allow the construction of a meaningful postal questionnaire. As a rapport and trust was built up with those that attended the focus groups, names as referrals were given that allowed a sampling frame for the first wave of respondents to the subsequent postal survey. The process of referrals continued, allowing a total of four waves and a response of 800 questionnaires. ■

In this example, note the non-random selection of the initial group of respondents through focus group invitations. This procedure was more efficient than random selection, which given the absence of an appropriate sampling frame would be very cumbersome. In other cases where an appropriate sampling frame exists (appropriate in terms of identifying the desired characteristics in a number of respondents, not in terms of being exhaustive – if it were exhaustive, a snowball sample would not be needed), random selection of respondents through probability sampling techniques may be more appropriate.

Probability sampling techniques

Probability sampling techniques vary in terms of sampling efficiency. Sampling efficiency is a concept that reflects a trade-off between sampling cost and precision. Precision refers to the level of uncertainty about the characteristic being measured. Precision is inversely related to sampling errors but positively related to cost. The greater the precision, the greater the cost, and most studies require a trade-off. The researcher should strive for the most efficient sampling design, subject to the budget allocated. The efficiency of a probability sampling technique may be assessed by comparing it with that of simple random sampling.

Simple random sampling (SRS)
A probability sampling technique in which each element has a known and equal probability of selection. Every element is selected independently of every other element, and the sample is drawn by a random procedure from a sampling frame.

Simple random sampling

In **simple random sampling (SRS)**, each element in the population has a known and equal probability of selection. Furthermore, each possible sample of a given size (n) has a known and equal probability of being the sample actually selected. This implies that every element is selected independently of every other element. The sample is drawn by a random procedure from a sampling frame. This method is equivalent to a lottery system in which names are placed in a container, the container is shaken and the names of the winners are then drawn out in an unbiased manner.

To draw a simple random sample, the researcher first compiles a sampling frame in which each element is assigned a unique identification number. Then random numbers are generated to determine which elements to include in the sample. The random numbers may be generated with a computer routine or a table (see Table 1 in the Appendix of Statistical Tables). Suppose that a sample of size 10 is to be selected from a sampling frame containing 800 elements. This could be done by starting with row 1 and column 1 of Table 1, considering the three rightmost digits, and going down the column until 10 numbers between 1 and 800 have been selected. Numbers outside this range are ignored. The elements corresponding to the random numbers generated constitute the sample. Thus, in our example, elements 480, 368, 130, 167, 570, 562, 301, 579, 475 and 553 would be selected. Note that the last three digits of row 6 (921) and row 11 (918) were ignored, because they were out of range. Using these tables is fine for small samples, but can be very tedious. A more pragmatic solution is to turn to random number generators in most data analysis packages. For example, in Excel, the Random Number Generation Analysis Tool allows you to set a number of characteristics of your target population, including the nature of distribution of the data, and to create a table of random numbers on a separate worksheet.

SRS has many desirable features. It is easily understood, the sample results may be projected to the target population, and most approaches to statistical inference assume that the data have been collected by simple random sampling. SRS suffers from at least four significant limitations, however. First, it is often difficult to construct a sampling frame that will permit a simple random sample to be drawn. Second, SRS can result in samples that are very large or spread over large geographic areas, thus increasing the time and cost of data collection. Third, SRS often results in lower precision with larger standard errors than other probability sampling techniques. Fourth, SRS may or may not result in a representative sample. Although samples drawn will represent the population well on average, a given simple random sample may grossly misrepresent the target population. This is more likely if the size of the sample is small. For these reasons, SRS is not widely used in marketing research. Procedures such as systematic sampling are more popular.

Systematic sampling

Systematic sampling
A probability sampling technique in which the sample is chosen by selecting a random starting point and then picking every *i*th element in succession from the sampling frame.

In **systematic sampling**, the sample is chosen by selecting a random starting point and then picking every *i*th element in succession from the sampling frame. The sampling interval, i, is determined by dividing the population size N by the sample size n and rounding to the nearest whole number. For example, there are 100,000 elements in the population and a sample of 1000 is desired. In this case, the sampling interval, i, is 100. A random number between 1 and 100 is selected. If, for example, this number is 23, the sample consists of elements 23, 123, 223, 323, 423, 523, and so on.[14]

Systematic sampling is similar to SRS in that each population element has a known and equal probability of selection. It is different from SRS, however, in that only the permissible samples of size n that can be drawn have a known and equal probability of selection. The remaining samples of size n have a zero probability of being selected.

For systematic sampling, the researcher assumes that the population elements are ordered in some respect. In some cases, the ordering (for example, alphabetical listing in a telephone book) is unrelated to the characteristic of interest. In other instances, the ordering is directly related to the characteristic under investigation. For example, credit card customers may be listed in order of outstanding balance, or firms in a given industry may be ordered according to annual sales. If the population elements are arranged in a manner unrelated to the characteristic of interest, systematic sampling will yield results quite similar to SRS.

On the other hand, when the ordering of the elements is related to the characteristic of interest, systematic sampling increases the representativeness of the sample. If firms in an industry are arranged in increasing order of annual sales, a systematic sample will include some small and some large firms. A simple random sample may be unrepresentative because it may contain, for example, only small firms or a disproportionate number of small firms. If the ordering of the elements produces a cyclical pattern, systematic sampling may decrease the representativeness of the sample. To illustrate, consider the use of systematic sampling to generate a sample of monthly department store sales from a sampling frame containing monthly sales for the last 60 years. If a sampling interval of 12 is chosen, the resulting sample would not reflect the month-to-month variation in sales.[15]

Systematic sampling is less costly and easier than SRS because random selection is done only once to establish a starting point. Moreover, random numbers do not have to be matched with individual elements as in SRS. Because some lists contain millions of elements, considerable time can be saved, which reduces the costs of sampling. If information related to the characteristic of interest is available for the population, systematic sampling can be used to obtain a more representative and reliable (lower sampling error) sample than SRS. Another relative advantage is that systematic sampling can even be used without knowledge of the elements of the sampling frame. For example, every *i*th person leaving a shop or passing a point in the street can be intercepted (provided very strict control of the flow of potential respondents is exercised). For these reasons, systematic sampling is often employed in consumer mail, telephone and street interviews, as illustrated by the following example.

example

Tennis's systematic sampling returns a smash[16]

Tennis magazine conducted a postal survey of its subscribers to gain a better understanding of its market. Systematic sampling was employed to select a sample of 1,472 subscribers from the publication's domestic circulation list. If we assume that the subscriber list had 1,472,000 names, the sampling interval would be 1,000 (1,472,000/1,472). A number from 1 to 1,000 was drawn at random. Beginning with that number, every subsequent 1,000th was selected.

An 'alert' postcard was mailed one week before the survey. A second, follow-up, questionnaire was sent to the whole sample 10 days after the initial questionnaire. There were 76 post office returns, so the net effective mailing was 1,396. Six weeks after the first mailing, 778 completed questionnaires were returned, yielding a response rate of 56%.

Stratified sampling

Stratified sampling
A probability sampling technique that uses a two-step process to partition the population into subsequent sub-populations, or strata. Elements are selected from each stratum by a random procedure.

Stratified sampling is a two-step process in which the population is partitioned into sub-populations, or strata. The strata should be mutually exclusive and collectively exhaustive in that every population element should be assigned to one and only one stratum and no population elements should be omitted. Next, elements are selected from each stratum by a random procedure, usually SRS. Technically, only SRS should be employed in selecting the elements from each stratum. In practice, sometimes systematic sampling and other probability sampling procedures are employed. Stratified sampling differs from quota sampling in that the sample elements are selected probabilistically rather than based on convenience or judgement. A major objective of stratified sampling is to increase precision without increasing cost.[17]

The variables used to partition the population into strata are referred to as stratification variables. The criteria for the selection of these variables consist of homogeneity, heterogeneity, relatedness and cost. The elements within a stratum should be as homogeneous as possible, but the elements in different strata should be as heterogeneous as possible. The stratification variables should also be closely related to the characteristic of interest. The more closely these criteria are met, the greater the effectiveness in controlling extraneous sampling variation. Finally, the variables should decrease the cost of the stratification process by being easy to measure and apply. Variables commonly used for stratification include demographic characteristics (as illustrated in the example for quota sampling), type of customer (e.g. credit card versus non-credit card), size of firm, or type of industry. It is possible to use more than one variable for stratification, although more than two are seldom used because of pragmatic and cost considerations. Although the number of strata to use is a matter of judgement, experience suggests the use of no more than six. Beyond six strata, any gain in precision is more than offset by the increased cost of stratification and sampling.

Another important decision involves the use of proportionate or disproportionate sampling. In proportionate stratified sampling, the size of the sample drawn from each stratum is proportionate to the relative size of that stratum in the total population. In disproportionate stratified sampling, the size of the sample from each stratum is proportionate to the relative size of that stratum and to the standard deviation of the distribution of the characteristic of interest among all the elements in that stratum. The logic behind disproportionate sampling is simple. First, strata with larger relative sizes are more influential in determining the population mean, and these strata should also exert a greater influence in deriving the sample estimates. Consequently, more elements should be drawn from strata of larger relative size. Second, to increase precision, more elements should be drawn from strata with larger standard deviations and fewer elements should be drawn from strata with smaller standard deviations. (If all the elements in a stratum are identical, a sample size of one will result in perfect information.) Note that the two methods are identical if the characteristic of interest has the same standard deviation within each stratum.

Disproportionate sampling requires that some estimate of the relative variation, or standard deviation of the distribution of the characteristic of interest, within strata be known. As this information is not always available, the researcher may have to rely on intuition and logic to determine sample sizes for each stratum. For example, large retail stores might be expected to have greater variation in the sales of some products as compared with small stores. Hence, the number of large stores in a sample may be disproportionately large. When the researcher is primarily interested in examining differences between strata, a common sampling strategy is to select the same sample size from each stratum.

Stratified sampling can ensure that all the important sub-populations are represented in the sample. This is particularly important if the distribution of the characteristic of interest in the population is skewed. For example, very few households have annual incomes that allow them to own a second home overseas. If a simple random sample is taken, households that have a second home overseas may not be adequately represented. Stratified sampling would guarantee that the sample contains a certain number of these households. Stratified sampling combines the simplicity of SRS with potential gains in precision. Therefore, it is a popular sampling technique.

Cluster sampling
A two-step probability sampling technique where the target population is first divided into mutually exclusive and collectively exhaustive sub-populations called clusters, and then a random sample of clusters is selected based on a probability sampling technique such as simple random sampling. For each selected cluster, either all the elements are included in the sample, or a sample of elements is drawn probabilistically.

Cluster sampling

In **cluster sampling**, the target population is first divided into mutually exclusive and collectively exhaustive sub-populations. These sub-populations or clusters are assumed to contain the diversity of respondents held in the target population. A random sample of clusters is selected, based on a probability sampling technique such as SRS. For each selected cluster, either all the elements are included in the sample or a sample of elements is drawn probabilistically. If all the elements in each selected cluster are included in the sample, the procedure is called one-stage cluster sampling. If a sample of elements is drawn probabilistically from each selected cluster, the procedure is two-stage cluster sampling. As shown in Figure 14.3, two-stage cluster sampling can be either simple two-stage cluster sampling involving SRS or probability proportionate to size (PPS) sampling. Furthermore, a cluster sample can have multiple (more than two) stages, as in multistage cluster sampling.

The key distinction between cluster sampling and stratified sampling is that in cluster sampling only a sample of sub-populations (clusters) is chosen, whereas in stratified sampling all the sub-populations (strata) are selected for further sampling. The objectives of the two methods are also different. The objective of cluster sampling is to increase sampling efficiency by decreasing costs, but the objective of stratified sampling is to increase precision. With respect to homogeneity and heterogeneity, the criteria for forming clusters are just the opposite of those for strata. Elements within a cluster should be as heterogeneous as possible, but clusters themselves should be as homogeneous as possible. Ideally, each cluster should be a small-scale representation of the population. In cluster sampling, a sampling frame is needed only for those clusters selected for the sample.

Area sampling
A common form of cluster sampling in which the clusters consist of geographic areas such as counties, housing tracts, blocks or other area descriptions.

A common form of cluster sampling is **area sampling**, in which the clusters consist of geographic areas, such as counties, housing districts or residential blocks. If only one level of sampling takes place in selecting the basic elements (for example, if the researcher samples blocks and then all the households within the selected blocks are included in the sample), the design is called one-stage area sampling. If two or more levels of sampling take place before the basic elements are selected (if the researcher samples blocks and then samples households within the sampled blocks), the design is called two-stage (or multistage) area sampling. The distinguishing feature of one-stage area sampling is that all the households in the selected blocks (or geographic areas) are included in the sample.

There are two types of two-stage cluster sampling designs, as shown in Figure 14.3. Simple two-stage cluster sampling involves SRS at the first stage (e.g. sampling blocks) as well as the second stage (e.g. sampling households within blocks). In this design the number of elements (e.g. households) selected at the second stage is the same for each sample cluster (e.g. selected blocks). This design is appropriate when the clusters are equal in size, that is, when the clusters contain approximately the same number of sampling units. If they differ greatly in size, however, simple two-stage cluster sampling can lead to biased estimates. Sometimes the clusters can be made of equal size by combining clusters. When this option is not feasible, probability proportionate to size (PPS) sampling can be used.

Probability proportionate to size (PPS)
A selection method where the probability of selecting a sampling unit in a selected cluster varies inversely with the size of the cluster. Therefore, the size of all the resulting clusters is approximately equal.

In **probability proportionate to size (PPS)** sampling, the clusters are sampled with probability proportional to size. The size of a cluster is defined in terms of the number of sampling units within that cluster. Thus, in the first stage, large clusters are more likely to be included than small clusters. In the second stage, the probability of selecting a sampling unit in a selected cluster varies inversely with the size of the cluster. Thus, the probability that any particular sampling unit will be included in the

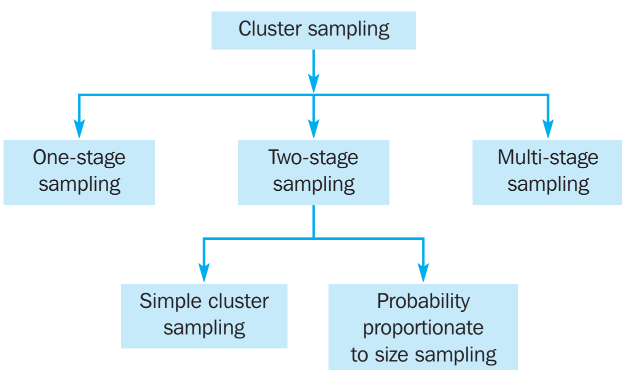

Figure 14.3 Types of cluster sampling

sample is equal for all units, because the unequal first stage probabilities are balanced by the unequal second stage probabilities. The numbers of sampling units included from the selected clusters are approximately equal.

Cluster sampling has two major advantages: feasibility and low cost. These advantages are illustrated in the following example where alternative means of drawing a sample were severely restricted without incurring great costs.

example

Sport and leisure demands in schools

The Sports Council has supported marketing research in the South West of England that has facilitated new facilities and sports development in a range of cities. The methodology involved using a postal survey which was sent to individuals in households. The electoral register acted as the sampling frame and a systematic sampling method was used. A major problem lay in sampling younger members of the community who were not named on the electoral register and had no known sampling frame that marketing researchers could access.

The solution lay in the use of a simple two-stage cluster sampling design. All schools and colleges within a target district could be identified; a complete and current sampling frame of schools and colleges was available. A simple random sample of all the schools and colleges constituted the first stage. Then a random sample of classes within the schools and colleges was taken (between the ages of 12 and 18). In this design, the number of elements (classes) selected at the second stage was the same for each sample cluster (school or college).

With the selected classes, permission was gained to administer the questionnaire to the whole class. This resulted in a very cost-effective means of data collection. As all the class completed the task together, a consistent means to motivate respondents and instructions could be given. ■

In many situations the only sampling frames readily available for the target population are clusters, not population elements. In the above example, the schools and their classes are known but not the pupils. It is often impossible to compile a list of all consumers in a population, given the resources and constraints. Lists of geographical areas, telephone exchanges and other clusters of consumers, however, can be constructed relatively easily. Cluster sampling is the most cost-effective probability sampling technique. This advantage must be weighed against several limitations. Cluster sampling results in relatively imprecise samples, and it is difficult to form clusters in which the elements are heterogeneous, because, for example, households in a block tend to be similar rather than dissimilar.[18] It can be difficult to compute and interpret statistics based on clusters.

Other probability sampling techniques

In addition to the four basic probability sampling techniques, there are a variety of other sampling techniques. Most of these may be viewed as extensions of the basic techniques and were developed to address complex sampling problems. Two techniques with some relevance to marketing research are sequential sampling and double sampling.

Sequential sampling
A probability sampling technique in which the population elements are sampled sequentially, data collection and analysis are done at each stage, and a decision is made as to whether additional population elements should be sampled.

In **sequential sampling**, the population elements are sampled sequentially, data collection and analysis are done at each stage, and a decision is made as to whether additional population elements should be sampled. The sample size is not known in advance, but a decision rule is stated before sampling begins. At each stage, this rule indicates whether sampling should be continued or whether enough information has been obtained. Sequential sampling has been used to determine preferences for two competing alternatives. In one study, respondents were asked which of two alternatives they preferred, and sampling was terminated when sufficient evidence was accumulated to validate a preference. It has also been used to establish the price differential between a standard model and a deluxe model of a consumer durable.[19]

Double sampling
A sampling technique in which certain population elements are sampled twice.

In **double sampling**, also called two-phase sampling, certain population elements are sampled twice. In the first phase, a sample is selected and some information is collected from all the elements in the sample. In the second phase, a sub-sample is drawn from the original sample and additional information is obtained from the elements in the sub-sample. The process may be extended to three or more phases, and the different phases may take place simultaneously or at different times. Double sampling can be useful when no sampling frame is readily available for selecting final sampling units but when the elements of the frame are known to be contained within a broader sampling frame. For example, a researcher wants to select households in a given city that consume apple juice. The households of interest are contained within the set of all households, but the researcher does not know which ones they are. In applying double sampling, the researcher would obtain a sampling frame of all households in the first phase. This would be constructed from the city directory or purchased. Then a sample of households would be drawn, using systematic random sampling to determine the amount of apple juice consumed. In the second phase, households that consume apple juice would be selected and stratified according to the amount of apple juice consumed. Then a stratified random sample would be drawn and detailed questions regarding apple juice consumption asked.[20]

Choosing non-probability versus probability sampling

The choice between non-probability and probability samples should be based on considerations such as the nature of the research, relative magnitude of non-sampling versus sampling errors, and variability in the population, as well as statistical and operational considerations (see Table 14.3).

Table 14.3 Choosing non-probability vs. probability sampling

Factors	*Conditions favouring the use of*	
	Non-probability sampling	*Probability sampling*
Nature of research	Exploratory	Conclusive
Relative magnitude of sampling and non-sampling errors	Non-sampling errors are larger	Sampling errors are larger
Variability in the population	Homogeneous (low)	Heterogeneous (high)
Statistical considerations	Unfavourable	Favourable
Operational considerations	Favourable	Unfavourable

For example, in exploratory research, the judgement of the researchers in selecting respondents with particular qualities may be far more effective than any form of probability sampling. On the other hand, in conclusive research where the researcher wishes to use the results to estimate overall market shares or the size of the total market, probability sampling is favoured. Probability samples allow statistical projection of the results to a target population.

For some research problems, highly accurate estimates of population characteristics are required. In these situations, the elimination of selection bias and the ability to calculate sampling error make probability sampling desirable. Probability sampling will not always result in more accurate results, however. If non-sampling errors are likely to be an important factor, then non-probability sampling may be preferable because the use of judgement may allow greater control over the sampling process.

Another consideration is the homogeneity of the population with respect to the variables of interest. A heterogeneous population would favour probability sampling because it would be more important to secure a representative sample. Probability sampling is preferable from a statistical viewpoint, as it is the basis of most common statistical techniques.

Probability sampling generally requires statistically trained researchers, generally costs more and takes longer than non-probability sampling, especially in the establishment of accurate sampling frames. In many marketing research projects, it is difficult to justify the additional time and expense. Therefore, in practice, the objectives of the study dictate which sampling method will be used.

Non-probability sampling is used in concept tests, package tests, name tests and copy tests where projections to the populations are usually not needed. In such studies, interest centres on the proportion of the sample that gives various responses or expresses various attitudes. Samples for these studies can be drawn using methods such as street interviewing and quota sampling. On the other hand, probability sampling is used when there is a need for highly accurate estimates of market share or sales volume for the entire market. National market tracking studies, which provide information on product category and brand usage rates as well as psychographic and demographic profiles of users, use probability sampling. Studies that use probability sampling generally employ telephone interviews. Stratified and systematic sampling are combined with some form of random-digit dialling to select the respondents.

Summary of sampling techniques

The strengths and weaknesses of cluster sampling and the other basic sampling techniques are summarised in Table 14.4. Table 14.5 describes the procedures for drawing probability samples.

Table 14.4 Strengths and weaknesses of sampling techniques

Technique	*Strengths*	*Weaknesses*
Non-probability sampling		
Convenience sampling	Least expensive, least time consuming, most convenient	Selection bias, sample not representative, not recommended for descriptive or causal research
Judgemental sampling	Low cost, convenient, not time consuming.Ideal for exploratory research designs	Does not allow generalisation, subjective
Quota sampling	Sample can be controlled for certain characteristics	Selection bias, no assurance of representativeness
Snowball sampling	Can estimate rare characteristics	Time consuming
Probability sampling		
Simple random sampling (SRS)	Easily understood, results projectable	Difficult to construct sampling frame, expensive, lower precision, no assurance of representativeness
Systematic sampling	Can increase representativeness, easier to implement than SRS, sampling frame not always necessary	Can decrease representativeness
Stratified sampling	Includes all important sub-populations, precision	Difficult to select relevant stratification variables, not feasible to stratify on many variables, expensive
Cluster sampling	Easy to implement, cost-effective	Imprecise, difficult to compute and interpret results

Table 14.5 Procedures for drawing probability samples

Simple random sampling

1 Select a suitable sampling frame.

2 Each element is assigned a number from 1 to N (population size).

3 Generate n (sample size) different random numbers between 1 and N using a software package or a table of simple random numbers (Table 1 in the Appendix of Statistical Tables). To use Table 1, select the appropriate number of digits (e.g. if $N = 900$, select three digits). Arbitrarily select a beginning number. Then proceed up or down until n different numbers between 1 and N have been selected. Discard 0, duplicate numbers, and numbers greater than N.

4 The numbers generated denote the elements that should be included in the sample.

Systematic sampling

1 Select a suitable sampling frame.

2 Each element is assigned a number from 1 to N (population size).

3 Determine the sampling interval i, where $i = N/n$. If i is a fraction, round to the nearest whole number.

4 Select a random number, r, between 1 and i, as explained in simple random sampling.

5 The elements with the following numbers will comprise the systematic random sample:

$$r, r + i, r + 2i, r + 3i, r + 4i \ldots r + (n-1)i$$

Stratified sampling

1 Select a suitable sampling frame.

2 Select the stratification variable(s) and the number of strata, H.

3 Divide the entire population into H strata. Based on the classification variable, each element of the population is assigned to one of the H strata.

4 In each stratum, number the elements from 1 to N_h (the population size of stratum h).

5 Determine the sample size of each stratum, n_h, based on proportionate or disproportionate stratified sampling, where

$$\sum_{h=1}^{H} n_h = n$$

6 In each stratum, select a simple random sample of size n_h.

Cluster sampling

We describe the procedure for selecting a two-stage PPS sample, because this represents the most commonly used general case.

1 Assign a number from 1 to N to each element in the population.

2 Divide the population into C clusters of which c will be included in the sample.

3 Calculate the sampling interval i, where $i = N/c$. If i is a fraction, round to the nearest whole number.

4 Select a random number, r, between 1 and i, as explained in simple random sampling.

5 Identify elements with the following numbers: $r, r + i, r + 2i, r + 3i \ldots, r + (c-1)i$.

6 Select the clusters that contain the identified elements.

7 Select sampling units within each selected cluster based on SRS or systematic sampling. The number of sampling units selected from each sample cluster is approximately the same and equal to n/c.

8 If the population of the cluster exceeds the sampling interval i, that cluster is selected with certainty. That cluster is removed from further consideration. Calculate the new proportion size, N^*, the number of clusters to be selected, c^* $(= c - 1)$, and the new sampling interval i^*. Repeat this process until each of the remaining clusters has a population less than the relevant sampling interval. If b clusters have been selected with certainty, select the remaining $c - b$ clusters according to steps 1 to 7. The fraction of units to be sampled from each cluster selected with certainty is the overall sampling fraction n/N. Thus, for clusters selected with certainty, we would select $n_s = (n/N)(N_1 + N_2 + \ldots + N_b)$ units. The units selected from clusters selected under PPS sampling will therefore be $n^* = n - n_s$.

International marketing research

Implementing the sampling design process in international marketing research is seldom easy. Several factors should be considered in defining the target population. The relevant element (respondent) may differ from country to country. In Europe, children play an important role in the purchase of children's cereals and may be seen as target respondents. In countries with authoritarian child-rearing practices, however, the mother or father may be the relevant target respondents. Accessibility also varies across countries. In Mexico, 'upper class' houses cannot be entered by strangers because of boundary walls and servants. Additionally, dwelling units may be unnumbered and streets unidentified, making it difficult to locate designated households.[21]

Developing an appropriate sampling frame is a difficult task. In many countries, particularly developing countries, reliable information about the target population may not be available from secondary sources. Government data may be unavailable or highly biased. Population lists may not be available commercially. The time and money required to compile these lists may be prohibitive. For example, in Saudi Arabia, there is no officially recognised census of population, no elections and hence no voter registration records, and no accurate maps of population centres. In this situation, the interviewers could be instructed to begin at specified starting points and to sample every *n*th dwelling until the specified number of units has been sampled.

Given the lack of suitable sampling frames, the inaccessibility of certain respondents, such as women in some cultures, and the dominance of personal interviewing, probability sampling techniques are uncommon in international marketing research. Imagine the problems involved in tracking down an accurate sampling frame in the following example.

example

Post-Deng China with a new 'middle class' of 35 million households[22]

China has been transformed from a centralised state system offering only two imported items (cigarettes and soft drinks) into a socialist market economy where consumers can buy Rolex watches, Burberry raincoats, Cadbury's chocolate, Kentucky Fried Chicken, Colgate toothpaste and Nike sports shoes and other international brands. With a population of 1.2 billion it is not surprising that companies are keen to enter China, where even niche markets can be huge.

While 'middle class' is a Western concept and as such does not exist in China, there are 'Xiao Kang' or Little Rich households. Xiao Kang is a state of society in Confucian ideology where people live and work happily, which in today's context means that the people eat well, dress smartly and live in nicely furnished homes equipped with consumer durables. There are estimated to be in the region of 35 million Xiao Kang families in China, a large and lucrative segment of population that totals 1.2 billion. ■

Quota sampling has been used widely in the developed and developing countries in both consumer and industrial surveys. Quota sampling has a long history of working well in Britain, France and Germany, but is a sampling method that is seen as 'unthinkable' for many US marketing researchers.[23] Snowball sampling is also appealing when the characteristic of interest is rare in the target population or when respondents are hard to reach. For example, it has been suggested that in Saudi Arabia graduate students be employed to hand-deliver questionnaires to relatives and friends.[24] These initial respondents can be asked for referrals to other potential respondents and so on. This approach would result in a large sample size and a high response rate.

Sampling techniques and procedures vary in accuracy, reliability and cost from country to country. If the same sampling procedures are used in each country, the results may not be comparable.[25] To achieve comparability in sample composition and representativeness, it may be desirable to use different sampling techniques in different countries.

Ethics in marketing research

The researcher has several ethical responsibilities to both the client and the respondents pertaining to sampling. With regard to the client, the researcher must develop a sampling design that best fits the project in an effort to minimise the sampling and non-sampling errors (see Chapter 3). When probability sampling can be used it should be.

When non-probability design such as convenience sampling is used, the limitations of the design should be explicit in any findings that are presented. It is unethical and misleading to treat non-probability samples as probability samples and to project the results to a target population. Appropriate definition of the population and the sampling frame, and application of the correct sampling techniques, are essential if the research is to be conducted and the findings used ethically.

Researchers must be extremely sensitive to preserving the anonymity of the respondents when conducting business-to-business research with small populations, particularly when reporting the findings to the client. When the population size is small, it is easier to discern the identities of the respondents than when the samples are drawn from a large population. Special care must be taken when sample details are too revealing and when using verbatim quotations in reports to the client. This problem is acute in areas such as employee research. Here a breach of a respondent's anonymity can cost the respondent a pay rise, a promotion, or even their employment. In such situations, special effort should be made to protect the identities of the respondents.

Internet and computer applications

Sampling potential respondents who are surfing the Internet is meaningful if the sample generated is representative of the target population. More and more industries are meeting this criterion. In software, computers, networking, technical publishing, semiconductors and graduate education, it is rapidly becoming feasible to use the Internet for sampling respondents for quantitative research, such as surveys. For internal customer surveys, where the client's employees share a corporate email system, an intranet survey is practical, even if workers have no access to the external Internet. Look at Professional Perspective 5 written by Ron Whelan on the Companion Website to see these issues discussed in more detail.

➤➤➤ *See Professional Perspective 5.*

To avoid sampling errors, the researcher must be able to control the pool from which the respondents are selected. Also, it must be ensured that the respondents do not respond more than once. These requirements are met by email surveys, in which the researcher selects specific respondents. Furthermore, the surveys can be encoded to match the returned surveys with their corresponding outbound emailings. This can also be accomplished with Web surveys by emailing invitations to selected respondents and asking them to visit the Website on which the survey is posted. In this case, the survey is posted in a hidden location on the Web, which is protected by a password. Hence, non-invited Web surfers are unable to access it.

Non-probability as well as probability sampling techniques can be implemented on the Internet. Moreover, the respondents can be pre-recruited or tapped online. Tapping visitors to a Website is an example of convenience sampling. Based on the researcher's judgement, certain qualifying criteria can be introduced to pre-screen the respondents. Even quotas can be imposed. However, the extent to which quotas will be met is limited by the number as well as the characteristics of visitors to the site.

Likewise, simple random sampling is commonly used. To prevent gathering information from the same professional respondents (professional in this context meaning respondents who take part in many surveys for their own enjoyment), some companies use a 'click-stream intercept', which randomly samples online users and gives them the opportunity to participate or decline.

Microcomputers and mainframes can make the sampling design process more effective and efficient. Random number generators are available in most data analysis packages. For example, in Excel, the Random Number Generation Analysis Tool allows you to set a number of characteristics of your target population, including the nature of distribution of the data, and to create a table of random numbers on a separate worksheet. Computers can also be used in the specification of the sampling frame. Geodemographic information systems such as Experian (www.experian.com) handle lists of population elements as well as geographical maps. Database packages can also be used to store and manipulate sampling frames, especially when the sampling frame is built up from multiple sources and duplicates need to be identified and eliminated. Once the sampling frame has been determined, simulations can be used to generate random numbers and select the sample directly from the database.

➤➤➤ *See Professional Perspectives 5, 20.*

Go to the Companion Website and read Professional Perspective 5 from Tim Macer. In 'Playing the Internet number game', Tim reviews an online sample ordering system, SSI-SNAP (www.surveysampling.com). See also Professional Perspective 20 'Online methodological meditations' by Ron Whelan. He tackles the issues of how representative Internet samples are, and the concerns about the self-completion nature of Internet interviews.

To experience how you can precisely define a target population and create a distinctive sampling frame, based upon an array of demographic and lifestyle characteristics, look at www.prospectlocator.com. Another good reference to evaluate sampling techniques can be found on http://trochim.human.cornell.edu/kb/sampprob.htm.

Summary

Information about the characteristics of a population may be obtained by conducting either a sample or a census. Budget and time limits, large population size, and small variance in the characteristic of interest favour the use of a sample. Sampling is also preferred when the cost of sampling error is low, the cost of non-sampling error is high, the nature of measurement is destructive, and attention must be focused on individual cases. The opposite set of conditions favours the use of a census.

Sampling design begins by defining the target population in terms of elements, sampling units, extent and time. Then the sampling frame should be determined. A sampling frame is a representation of the elements of the target population. It consists of a list of directions for identifying the target population. At this stage, it is important to recognise any sampling frame errors that may exist. The next step involves selecting a sampling technique and determining the sample size. In addition to quantitative analysis, several qualitative considerations should be taken into account in determining the sample size. Execution of the sampling process requires detailed specifications for each step in the sampling process. Finally, the selected sample should be validated by comparing characteristics of the sample with known characteristics of the target population.

Sampling techniques may be classified as non-probability and probability techniques. Non-probability sampling techniques rely on the researcher's judgement.

Consequently, they do not permit an objective evaluation of the precision of the sample results, and the estimates obtained are not statistically projectable to the population. The commonly used non-probability sampling techniques include convenience sampling, judgemental sampling, quota sampling and snowball sampling.

In probability sampling techniques, sampling units are selected by chance. Each sampling unit has a non-zero chance of being selected, and the researcher can pre-specify every potential sample of a given size that could be drawn from the population as well as the probability of selecting each sample. It is also possible to determine the precision of the sample estimates and inferences and make projections to the target population. Probability sampling techniques include simple random sampling, systematic sampling, stratified sampling, cluster sampling, sequential sampling and double sampling. The choice between probability and non-probability sampling should be based on the nature of the research, degree of error tolerance, relative magnitude of sampling and non-sampling errors, variability in the population, and statistical and operational considerations.

When conducting international marketing research, it is desirable to achieve comparability in sample composition and representativeness even though this may require the use of different sampling techniques in different countries. It is unethical and misleading to treat non-probability samples as probability samples and to project the results to a target population.

Questions

1. Under what conditions would a sample be preferable to a census? A census preferable to a sample?
2. Describe the sampling design process.
3. How should the target population be defined? How does this definition link with the definition of a marketing research problem?
4. What is a sampling unit? How is it different from the population element?
5. To what extent may the availability of sampling frames determine the definition of a population?
6. What qualitative factors should be considered in determining the sample size?
7. How do probability sampling techniques differ from non-probability sampling techniques? What factors should be considered in choosing between probability and non-probability sampling?
8. What is the least expensive and least time-consuming of all sampling techniques? What are the major limitations of this technique?
9. What is the major difference between judgemental and convenience sampling? Give examples of where each of these techniques may be successfully applied.
10. Describe snowball sampling. How may the technique be supported by qualitative research techniques?
11. What are the distinguishing features of simple random sampling?
12. Describe the procedure for selecting a systematic random sample.
13. Describe stratified sampling. What are the criteria for the selection of stratification variables?
14. What are the differences between proportionate and disproportionate stratified sampling?
15. Describe the cluster sampling procedure. What is the key distinction between cluster sampling and stratified sampling?

Notes

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