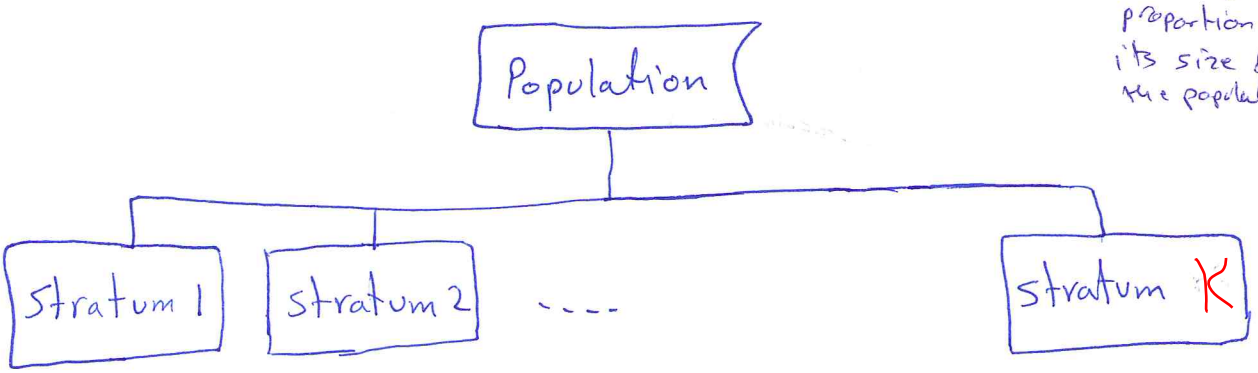
7.7 Other Sampling Methods:

In this section we provide an alternative sampling methods other than simple random sampling.

Sampling Methods:

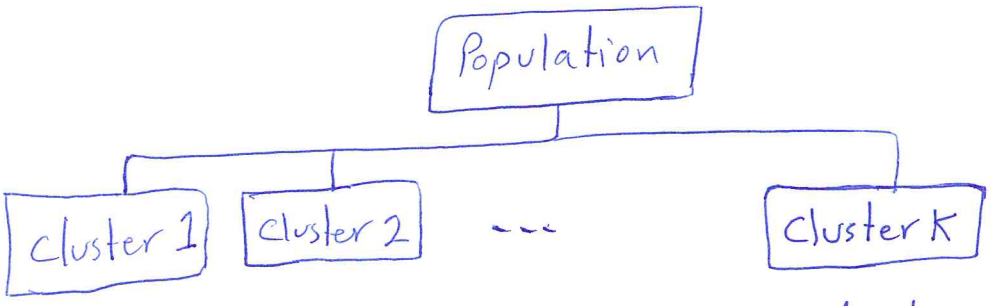
1. Simple random sampling: (Finite Population) A sample selected s.t each possible sample of size n has the same prob. of being selected.
2. Stratified Random Sampling: A probability sampling elements selected from population with know prob. of being included in the sample. method in which the population is first divided into strata (small groups) and a simple random sample is then taken from each stratum. ← proportion to its size from the population



- Each element in the population belongs to one and only one stratum
- Strat can be department, location, age, industry type ...
- Stratified random sampling workes best (gives a good estimat) when the variance among elements in each stratum is small. (the elements of each stratum are as much alike as possible).
- Thus, the stratified random sampling depends on how homogenous the elements are within the strata.

- If elements within strata are alike, then strata will have low variance
  ⇒ Thus, relatively small sample sizes can be used to obtain good estimates
- If strata are homogenous, then the stratified random sampling procedure provides results as precise as those of simple random sampling by using a smaller total sample size.

[3] Cluster Sampling: A probability sampling method in which the population is first divided into clusters and then a simple random sample of the clusters is taken.



- The elements in the population are first divided into separate groups called clusters.
- Each element in the population belongs to one and only one cluster.
- Cluster sampling provides the best results when the elements within the clusters are not alike (each cluster is a representative small-scale version of the entire population.
- Thus, cluster sampling depends on how representative each cluster is of the entire population.
  - If all clusters are alike (= they have the same representative), then sampling a small number of clusters will provide good estimate of the population parameters.
- Example of cluster sampling is area sampling where cluster are city blocks.
- Cluster sampling requires a larger total sample size than
  - simple random sampling and
  - stratified random sampling.

  but costs less because the data can be collected in each cluster in a shorter time, and using only one interviewer.

Example: Suppose the Dep. of agriculture wishes to investigate the use of pesticides by farmers in Palestine

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A cluster sample could be taken by identifying different ~~cantri~~ cities as clusters.

A sample of these cities would then be chosen at random all farmers in these selected cities would be included in the sample.

[4] Systematic Sampling: A probability sampling in which we randomly select one of the first k elements and then select the k^{th} element thereafter.

- When the population is Large, it's time consuming to select a simple random sample by finding random numbers, counting, until the corresponding element. So we use Systematic Sampling:
- For example: A population of 5000 elements.
  Suppose we need a sample of size 50 elements
  $\frac{5000}{50} = 100$
  - A systematic sample selects randomly one elemen in the first 100 elements (65^{th} (suppose it was 65))
  - The systematic sample will be the elements whose orders are:
    65^{th}, $65^{th}+100$, $65^{th}+200$, $65^{th}+300$, ..., $65^{th}+4900$
- That is, we move systematically through the population List, and identifying every 100^{th} elemen after the first element is randomly selected
- Systematic sampling in this way is easier than simple random sample and it has the properties of a simple random sample since the first element is randomly selected.

5 Convenience Sampling: A nonprobability method of sampling whereby elements are selected for the sample on the basis of convenience.

- Elements are included in the sample without know probabilities.
- For example: The university send a sample of selected professors to participate in an international conference, in specific field.
  "Volunteer panels" متطوعين

- Convenience samples are easy to select, but it is impossible to evaluate the "goodness" of the sample in terms of its representative of the population.
- Convenience samples may provide a good results or may not.
- We should be cautious to use the results of convenience sampling to make inferences about the population, since no statistical methods applied here.

6 Judgment Sampling: A nonprobability method of sampling where by elements are selected for the sample based on the judgment of the person doing the study.

- The person selects elements of the population that he/she feels they are most representative of the population.
- This method is easy way to select a sample.
- Aa example is that a political party select a two or three senators to make an TV interview since they reflect the general opinion of all senators.
- We should be careful to use the results of the judgment sampling to make inference about the population.

Summary:

- We recommend to use prob. sampling methods:
  - simple random sampling
  - stratified random sampling
  - cluster sampling
  - systematic sampling

  → propability sampling

because for these methods, formulas are available for evaluating the "goodness" of the sample results in terms of the closeness of the results to the population parameters, being estimated.

- An evaluation of the goodness cannot be made with
  - convenience sampling and
  - judgment sampling.

  → non propability sampling

Thus, a great care should be used in interpreting the results based on nonprobability sampling methods.

Methods of sampling from a population

It would normally be impractical to study a whole population, for example when doing a questionnaire survey. Sampling is a method that allows researchers to infer information about a population based on results from a subset of the population, without having to investigate every individual. Reducing the number of individuals in a study reduces the cost and workload, and may make it easier to obtain high quality information.

If a sample is to be used, by whatever method it is chosen, it is important that the individuals selected are representative of the whole population. This may involve specifically targeting hard to reach groups.

There are several different sampling techniques available, and they can be subdivided into two groups: probability sampling and non-probability sampling.

In probability (random) sampling, you start with a complete sampling frame of all eligible individuals from which you select your sample. In this way, all eligible individuals have a chance of being chosen for the sample, and you will be more able to generalise the results from your study. Probability sampling methods tend to be more time-consuming and expensive than non-probability sampling.

In non-probability (non-random) sampling, you do not start with a complete sampling frame, so some individuals have no chance of being selected. Consequently, you cannot estimate the effect of sampling error and there is a significant risk of ending up with a non-representative sample which produces non-generalisable results. However, non-probability sampling methods tend to be cheaper and more convenient, and they are useful for exploratory research and hypothesis generation.

Probability Sampling Methods

1. Simple random sampling

In this case each individual is chosen entirely by chance and each member of the population has an equal chance, or probability, of being selected.

One way of obtaining a random sample is to give each individual in a population a number, and then use a table of random numbers to decide which individuals to include. For example, if you have a sampling frame of 1000 individuals, labelled 0 to 999, use groups of three digits from the random number table to pick your sample. So, if the first three numbers from the random number table were 094, select the individual labelled "94", and so on.

As with all probability sampling methods, simple random sampling allows the sampling error to be calculated and reduces selection bias. A specific advantage is that it is the most straightforward method of probability sampling.

2. Systematic sampling

Individuals are selected at regular intervals from the sampling frame. The intervals are chosen to ensure an adequate sample size. If you need a sample size n from a population of size N, you should select every N/n^{th} individual for the sample.

For example, if you wanted a sample size of 100 from a population of 1000, select every 1000/100 = 10^{th} member of the sampling frame.

Systematic sampling is often more convenient than simple random sampling, and it is easy to administer. However, it may also lead to bias, as an example, if a group of students were being selected to get their opinions on college facilities, but the Student Record Department's central list of all students was arranged such that the sex of students alternated between male and female, choosing an even interval (e.g. every 20^{th} student) would result in a sample of all males or all females.

3. Stratified sampling

In this method, the population is first divided into subgroups (or strata) who all share a similar characteristic. It is used when we might reasonably expect the measurement of interest to vary between the different subgroups, and we want to ensure representation from all the subgroups.

For example, in a study of stroke outcomes, we may stratify the population by sex, to ensure equal representation of men and women. The study sample is then obtained by taking equal sample sizes from each stratum.

In stratified sampling, it may also be appropriate to choose non-equal sample sizes from each stratum. For example, in a study of the health outcomes of nursing staff in a county, if there are three hospitals each with different numbers of nursing staff (hospital A has 500 nurses, hospital B has 1000 and hospital C has 2000), then it would be appropriate to choose the sample numbers from each hospital *proportionally* (e.g. 10 from hospital A, 20 from hospital B and 40 from hospital C).

Stratified sampling improves the accuracy and representativeness of the results by reducing sampling bias. However, it requires knowledge of the appropriate characteristics of the sampling frame (the details of which are not always available), and it can be difficult to decide which characteristic(s) to stratify by.

4. Clustered sampling

In a clustered sample, subgroups of the population are used as the sampling unit, rather than individuals. The population is divided into subgroups, known as clusters, which are randomly selected to be included in the study.

For example individual GP practices or towns could be identified as clusters. In single-stage cluster sampling, all members of the chosen clusters are then included in the study. In two-stage cluster sampling, a selection of individuals from each cluster is then randomly selected for inclusion. Clustering should be taken into account in the analysis. The General Household survey, which is undertaken annually in England, is a good example of a (one-stage) cluster sample. All members of the selected households (clusters) are included in the survey.

Cluster sampling can be more efficient that simple random sampling, especially where a study takes place over a wide geographical region. For instance, it is easier to contact lots of individuals in a few GP practices than a few individuals in many different GP practices. Disadvantages include an increased risk of bias, if the chosen clusters are not representative of the population, resulting in an increased sampling error.

Non-Probability Sampling Methods

1. Convenience sampling

Convenience sampling is an easy method of sampling, because participants are selected based on availability and willingness to take part. Useful results can be obtained, but the results are subject to significant bias, because those who volunteer to take part may be different from those who choose not to (volunteer bias), and the sample may not be representative of other characteristics.

Note: volunteer bias is a risk of all non-probability sampling methods.

2. Judgement (or Purposive) Sampling

Also known as selective, or subjective, sampling. This technique relies on the judgement of the researcher when choosing who to ask to participate. Researchers may implicitly choose a "representative" sample to suit their needs, or specifically approach individuals with certain characteristics. This approach is often used by the media when canvassing the public for opinions and in qualitative research.

Judgement sampling has the advantage of being time-and cost-effective to perform whilst resulting in a range of responses (particularly useful in qualitative research). However, in addition to volunteer bias, it is also subject to errors of judgement by the researcher and the findings will not necessarily be representative.

3. Quota sampling

This method of sampling is often used by market researchers. Interviewers are given a quota of subjects of a specified type in order to recruit. For example, an interviewer might be told to go out and select 20 adult men, 20 adult women, 10 teenage girls and 10 teenage boys so that they could interview them about their television viewing. Ideally the quotas chosen would proportionally represent the characteristics of the underlying population.

This has the advantage of being relatively straightforward and potentially representative, but the selected sample may not be representative of other characteristics that weren't considered (a consequence of the non-random nature of sampling).

4. Snowball sampling

This method is commonly used in social sciences when investigating hard-to-reach groups. Existing subjects are asked to nominate further subjects known to them, so the sample increases in size like a rolling snowball. For example, when carrying out a survey of risk behaviours amongst drug users, participants may be asked to nominate other users to be interviewed.

Snowball sampling can be effective when a sampling frame is difficult to identify. However, by selecting friends of friends, there is a significant risk of selection bias (choosing a large number of people with similar characteristics or views.