Sampling

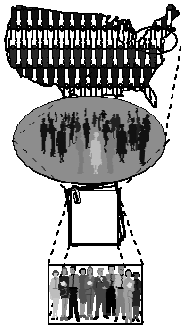
Why Sample?

- Why not study everyone?
- Debate about Census vs. sampling

Problems in Sampling?

- What problems do you know about?
- What issues are you aware of?
- What questions do you have?

Key Sampling Concepts



Who do you want to generalize to? — The Theoretical Population

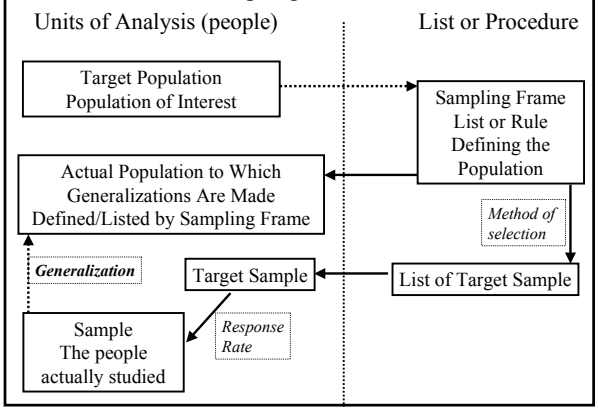
What population can you get access to? — The Study Population

How can you get access to them? — The Sampling Frame

Who is in your study? — The Sample

Copyright ©2002, William M.K. Trochim, All Rights Reserved

Sampling Process



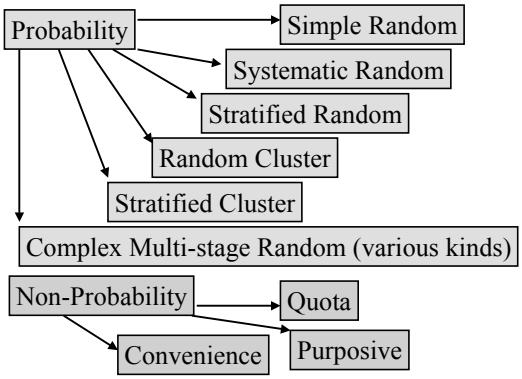
Key Ideas

- Distinction between the population of interest and the actual population defined by the sampling frame
- Generalizations can be made only to the actual population
- Understand crucial role of the sampling frame

Sampling Frame

- The list or procedure defining the POPULATION. (From which the sample will be drawn.)
- Distinguish sampling frame from sample.
- Examples:
  - Telephone book
  - Voter list
  - Random digit dialing
- Essential for probability sampling, but can be defined for nonprobability sampling

Types of Samples



Probability Samples

- A probability sample is one in which each element of the population has a **known non-zero** probability of selection.
- Not a probability sample of some elements of population cannot be selected (have zero probability)
- Not a probability sample if probabilities of selection are not known.

Probability Sampling

- Cannot guarantee "representativeness" on all traits of interest
- A sampling plan with known statistical properties
- Permits statements like: "The probability is .99 that the true population correlation falls between .46 and .56."

Sampling Frame is Crucial in Probability Sampling

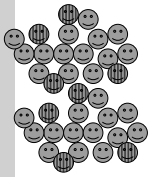
- If the sampling frame is a poor fit to the population of interest, random sampling from that frame cannot fix the problem
- The sampling frame is non-randomly chosen. Elements not in the sampling frame have zero probability of selection.
- Generalizations can be made ONLY to the actual population defined by the sampling frame

Types of Probability Samples

- Simple Random
- Systematic Random
- Stratified Random
- Random Cluster
- Stratified Cluster
- Complex Multi-stage Random (various kinds)

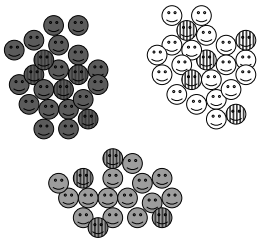
Simple Random Sampling

- Each element in the population has an equal probability of selection AND each combination of elements has an equal probability of selection
- Names drawn out of a hat
- Random numbers to select elements from an ordered list



Stratified Random Sampling-1

- Divide population into groups that differ in important ways
- Basis for grouping must be known before sampling
- Select random sample from within each group



Stratified Random Sampling-2

- For a given sample size, reduces error compared to simple random sampling IF the groups are different from each other
- Tradeoff between the cost of doing the stratification and smaller sample size needed for same error
- Probabilities of selection may be different for different groups, as long as they are known
- Oversampling small groups improves inter-group comparisons

Systematic Random Sampling-1

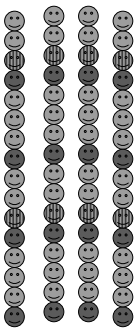
- Each element has an equal probability of selection, but combinations of elements have different probabilities.
- Population size N, desired sample size n, sampling interval k=N/n.
- Randomly select a number j between 1 and k, sample element j and then every k^{th} element thereafter, j+k, j+2k, etc.
- Example: N=64, n=8, k=64/8=8. Random j=3.

Systematic Random Sampling-2

- Has same error rate as simple random sample if the list is in random or haphazard order
- Provides the benefits of implicit stratification if the list is grouped

Systematic Random Sampling-3

- Runs the risk of error if periodicity in the list matches the sampling interval
- This is rare.
- In this example, every 4^{th} element is red, and red never gets sampled. If j had been 4 or 8, ONLY reds would be sampled.

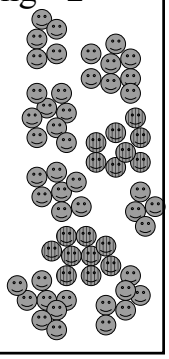


Random Cluster Sampling - 1

- Done correctly, this is a form of random sampling
- Population is divided into groups, usually geographic or organizational
- Some of the groups are randomly chosen
- In pure cluster sampling, whole cluster is sampled.
- In simple multistage cluster, there is random sampling within each randomly chosen cluster

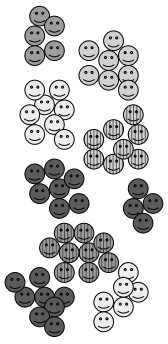
Random Cluster Sampling - 2

- Population is divided into groups
- Some of the groups are randomly selected
- For given sample size, a cluster sample has more error than a simple random sample
- Cost savings of clustering may permit larger sample
- Error is smaller if the clusters are **similar** to each other



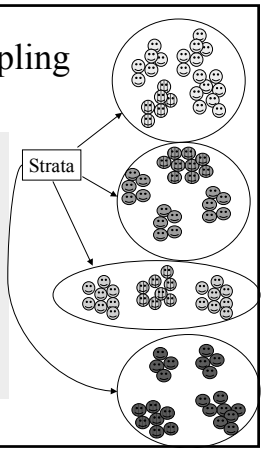
Random Cluster Samplng - 3

- Cluster sampling has very high error if the clusters are different from each other
- Cluster sampling is NOT desirable if the clusters are different
- It IS random sampling: you randomly choose the clusters
- But you will tend to omit some kinds of subjects



Stratified Cluster Sampling

- Reduce the error in cluster sampling by creating strata of clusters
- Sample one cluster from each stratum
- The cost-savings of clustering with the error reduction of stratification



Stratification vs. Clustering

Stratification

- Divide population into groups different from each other: sexes, races, ages
- Sample randomly from each group
- Less error compared to simple random
- More expensive to obtain stratification information before sampling

Clustering

- Divide population into comparable groups: schools, cities
- Randomly sample some of the groups
- More error compared to simple random
- Reduces costs to sample only some areas or organizations

Stratified Cluster Sampling

- Combines elements of stratification and clustering
- First you define the clusters
- Then you group the clusters into strata of clusters, putting similar clusters together in a stratum
- Then you randomly pick one (or more) cluster from each of the strata of clusters
- Then you sample the subjects within the sampled clusters (either all the subjects, or a simple random sample of them)

Multi-stage Probability Samples –1

- Large national probability samples involve several stages of stratified cluster sampling
- The whole country is divided into geographic clusters, metropolitan and rural
- Some large metropolitan areas are selected with certainty (certainty is a non-zero probability!)
- Other areas are formed into strata of areas (e.g. middle-sized cities, rural counties); clusters are selected randomly from these strata

Multi-stage Probability Samples –2

- Within each sampled area, the clusters are defined, and the process is repeated, perhaps several times, until blocks or telephone exchanges are selected
- At the last step, households and individuals within household are randomly selected
- Random samples make multiple call-backs to people not at home.

The Problem of Non-Response - 1

- You can randomly pick elements from sampling frame and use them to randomly select people
- But you cannot make people respond
- Non-response destroys the generalizeability of the sample. You are generalizing to people who are willing to respond to surveys
- If response is 90% or so, not so bad. But if it is 50%, this is a serious problem

The Problem of Non-Response - 2

- Multiple call-backs are essential for trying to reduce non-response bias
- Samples without call-backs have high bias: cannot really be considered random samples
- Response rates have been falling
- It is very difficult to get above a 60% response rate
- You do the best you can, and try to estimate the effect of the error by getting as much information as possible about the predictors of non-response.

Non-probability Samples

- Convenience
- Purposive
- Quota

Convenience Sample

- Subjects selected because it is easy to access them.
- No reason tied to purposes of research.
- Students in your class, people on State Street, friends

Purposive Samples

- Subjects selected for a good reason tied to purposes of research
- Small samples < 30, not large enough for power of probability sampling.
  - Nature of research requires small sample
  - Choose subjects with appropriate variability in what you are studying
- Hard-to-get populations that cannot be found through screening general population

Quota Sampling

- Pre-plan number of subjects in specified categories (e.g. 100 men, 100 women)
- In uncontrolled quota sampling, the subjects chosen for those categories are a convenience sample, selected any way the interviewer chooses
- In controlled quota sampling, restrictions are imposed to limit interviewer's choice
- No call-backs or other features to eliminate convenience factors in sample selection

Quota Vs Stratified Sampling

- In Stratified Sampling, selection of subject is random. Call-backs are used to get that particular subject.
- Stratified sampling without call-backs may not, in practice, be much different from quota sampling.

- In Quota Sampling, interviewer selects first available subject who meets criteria: is a convenience sample.
- Highly controlled quota sampling uses probability sampling down to the last block or telephone exchange

But you should know the difference for the test!!

Sample Size

- Heterogeneity: need larger sample to study more diverse population
- Desired precision: need larger sample to get smaller error
- Sampling design: smaller if stratified, larger if cluster
- Nature of analysis: complex multivariate statistics need larger samples
- Accuracy of sample depends upon sample size, not ratio of sample to population

Sampling in Practice

- Often a non-random selection of basic sampling frame (city, organization etc.)
- Fit between sampling frame and research goals must be evaluated
- Sampling frame as a concept is relevant to all kinds of research (including nonprobability)
- Nonprobability sampling means you cannot generalize beyond the sample
- Probability sampling means you can generalize to the population defined by the sampling frame