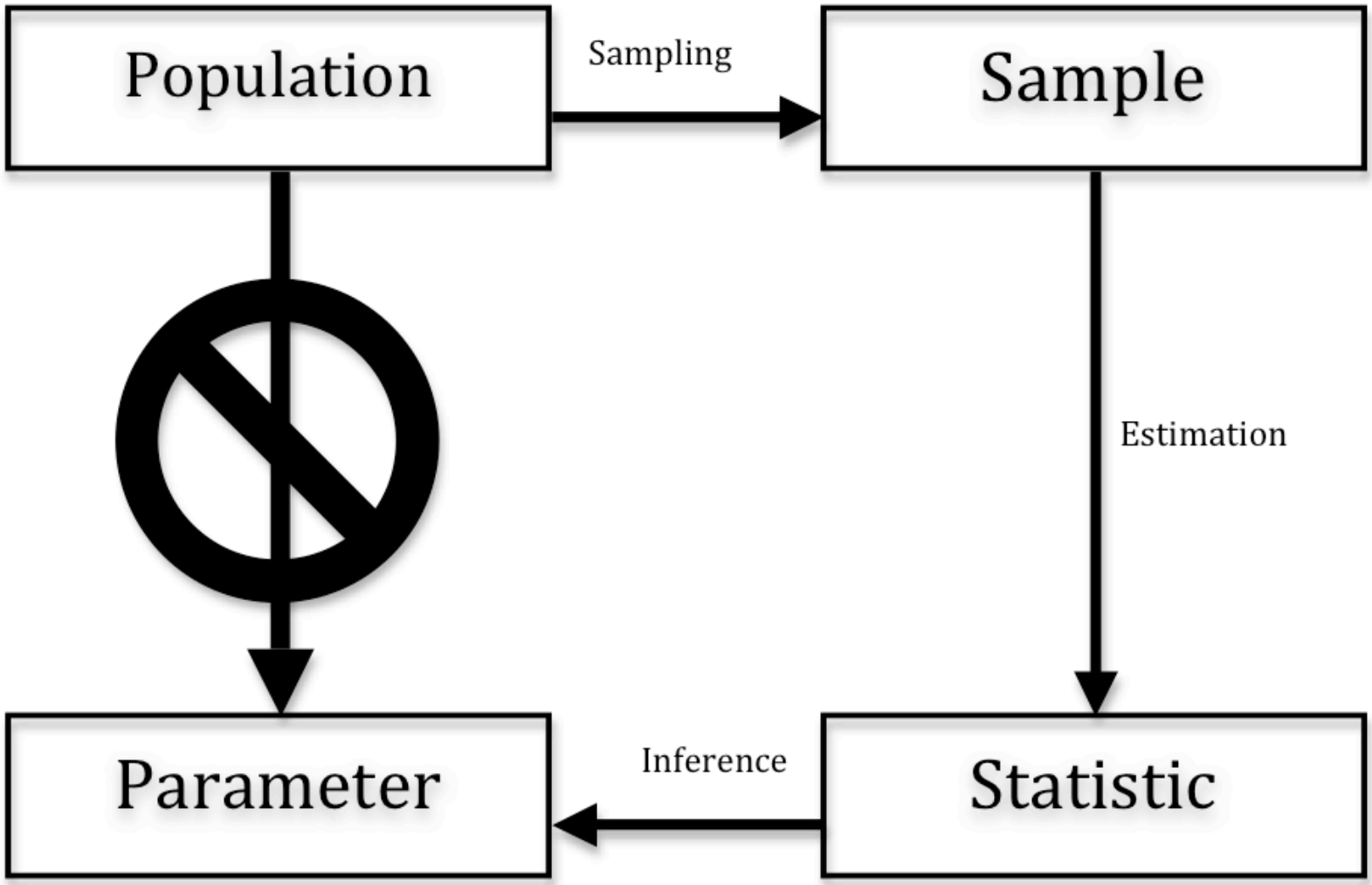
PLSC 502 – Autumn 2016
Sampling

October 4, 2016

What We Do


Population
Sampling
Sample
Estimation
Parameter
Inference
Statistic

Some Terminology

- **Population**: All of the units of analysis; there are $\mathfrak{N}$ units in the population.
- **Units of analysis**: The "things" that make up the population.
- **Sample**: A subgroup of units from some larger population.
- **Sampling frame**: The pool of units of analysis available to be sampled.
- **Primary sampling units**: The "things" being sampled.
- **Sample size**: The number of units sampled from the population. Denoted N.
- **Stratum** (plural: strata): A subgroup of the population sharing a common trait or traits.

Two Problems With Samples

Bias

- *Systematic* differences between the sample and the population.
- Usually due to the sampling (or research) design.

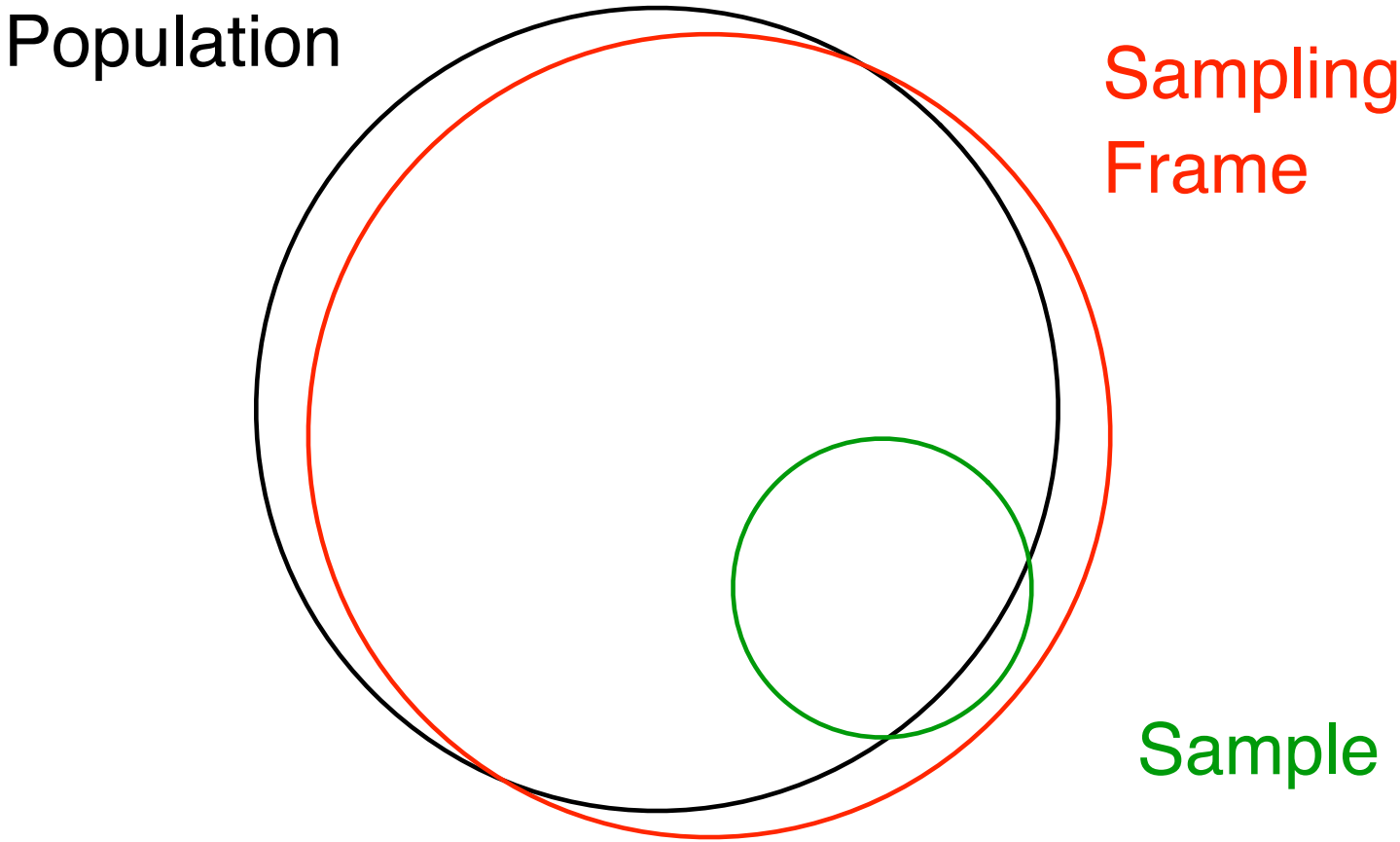
Sampling Error

- Differences between the sample and the population that are *nonsystematic*.
- Due to the randomness inherent to the sampling design.

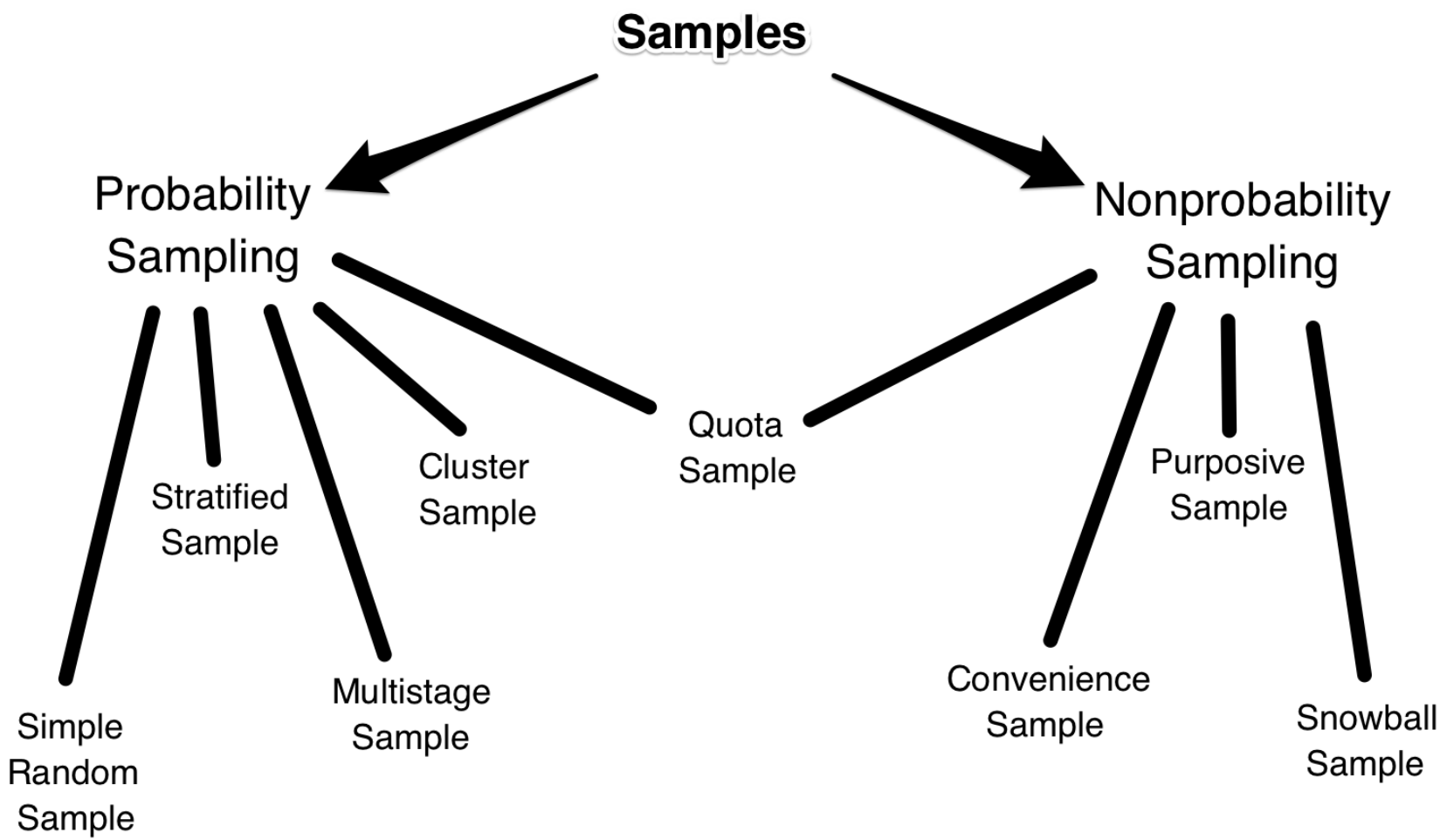
In general:

Bias is a much bigger problem than sampling error.

Population vs. Sampling Frame



Sample Types



Simple Random Sampling

Any sampling design where $\Pr(\text{Unit } i \text{ is sampled}) = \frac{1}{\mathfrak{N}} \ \forall \ i$.

or

Any sampling design where the probability of any given unit being selected into the sample is the same as any other unit in the population.

Simple Random Sampling: Pros and Cons

The Good:

- Mathematically easy to understand and implement
- Leads to the simplest / most straightforward methods of inference

The Bad:

- Difficult to define and draw... Must
  - *Know* every unit in the population, and
  - Be able to *include* all selected units in the sample drawn.
- Can yield poor results for small subpopulations / strata.

Stratified Sampling

Steps:

1. Divide the sample into strata based on predefined characteristics.
2. Conduct simple random sampling within each stratum.

For two groups A and B with populations $\mathfrak{N}_A$ and $\mathfrak{N}_B$ ($\mathfrak{N}_A + \mathfrak{N}_B = \mathfrak{N}$) respectively:

- If Pr(Unit $i_{A,B}$ is sampled) $= \frac{1}{\mathfrak{N}_{A,B}} \ \forall \ i_{A,B}$, then we have a *proportional stratified sample*.
- If (say) Pr(Unit i_A is sampled) $> \frac{1}{\mathfrak{N}_A}$, then we have *oversampled* from A (and *undersampled* from B).

Cluster Sampling

Steps:

1. Divide the sample into clusters based on predefined characteristics.
2. Draw a simple random sample of the clusters.
3. Include all units in each selected cluster in the final sample.

Cluster sampling:

- Changes the PSU from the unit of analysis to the cluster...
- Makes Pr(sample unit i) nonconstant / undefined
- *Most major media polls are done via cluster sampling*

Multistage Sampling

Steps:

1. Select a "cluster," identify subclusters of units within the cluster, etc. until we get to the "lowest" level cluster.
2. Select – randomly or in a stratified way – some number of top-level clusters.
3. Within each selected cluster, select – again, randomly or stratifying – some number of subclusters.
4. Within subclusters, select sub-subclusters, etc.
5. At the "lowest" subcluster level, select some number of units from each sub-cluster.

Multistage Sampling

Example (Agresti and Finlay): sample survey respondents by first selecting blocks, then selecting houses within blocks, then selecting residents within each (selected) house.

- Blocks are *clusters*, houses are *subclusters*, and the individuals are the units finally sampled.
- Allows for probability samples without knowing identities of every unit sampled, via sampling rules (e.g., "select one person from among those in each house with equal probability.")
- *Most large, national surveys are conducted using multistage sampling.*

Nonprobability Samples

A sample where probability that every unit is in the sample is not (or cannot be) known.

Flavors:

- **Convenience Sampling**: What the same suggests.
- **Purposive Sampling**: The researcher selects units on the basis of whether s/he believes they ought to be in the sample.
- **Snowball Sampling**: Selects a unit, and then sample other units with some relationship to that first unit.

Quota Sampling

Researcher samples units within strata up to some quota, and then stops.

- E.g., a survey researcher might question 100 men and 100 women.
- Used a great deal in pre-WWII studies.
- Combined with (say) convenience sampling $\rightarrow$ nonprobability sample.
- Combined with probability (e.g., stratified) sampling $\rightarrow$ better.

Key Points

- Probability samples yield sampling error.
  - Smallest = (generally) simple random sampling
  - Stratified *can* be smaller
  - Multi-stage = complex...
- Nonprobability samples can lead to bias; also have (complex) sampling error.

The Margin of Error (MOE)

Sampling error is the (random) difference between the value you want to know in the population and its respective value in the sample.

Characteristics:

- Intuition: "Repeated samples"
- A function of:
  - The sample size,
  - The sampling design, and
  - The size of the population.

MOE Example

Consider the proportion Q of observations in the population that have some (binary) trait. For a simple random sample of size N, the margin of error (sampling error) for the sample proportion q is:

$$\text{Standard error} = \sqrt{\frac{q(1-q)}{N}}$$

We typically calculate relative sampling error for a given *level of confidence*...

MOE and Sample Size