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Sampling Methods

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Definition of sampling

Procedure by which some members of the population are selected as representatives of the entire population

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Study population

The study population is the population to which the results of the study will be inferred

The study population depends upon the research question

- How many injections do people received each year in India?
  - Study population: Population of India
- How many needle-sticks health care workers experience each year in India?
  - Study population: Health care workers of India
- How many hospitals have a needle-sticks prevention policy in India
  - Study population: Hospitals of India

The sample needs to be representative of the population in terms of time

- Seasonality
- Day of the week
- Time of the day

The sample needs to be representative of the population in terms of place

- Urban
- Rural

The sample needs to be representative of the population in terms of persons

- Age
- Sex
- Other demographic characteristics

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Definition of sampling terms

- Sampling unit (Basic sampling unit, BSU)
  - Elementary unit that will be sampled
    - People
    - Health care workers
    - Hospitals
- Sampling frame
  - List of all sampling units in the population
- Sampling scheme
  - Method used to select sampling units from the sampling frame

Why do we sample populations?

- Obtain information from large populations
- Ensure the efficiency of a study
- Obtain more accurate information

Population

Sample

Practical example

- The Ministry of Health of a country X wants to estimate the proportion of children in elementary schools who have been immunized against childhood infectious diseases
- The task must be completed in one month
- The objective is to estimate the proportion of immunized children

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Type of samples

- Non-probability samples
  - Probability of being selected is unknown
  - Convenience samples
    - Biased
    - Best or worst scenario
  - Subjective samples
    - Based on knowledge
    - Time/resources constraints
- Probability samples

Type of samples

- Non-probability samples
- Probability samples
  - Every unit in the population has a known probability of being selected
  - Only sampling method that allows to draw valid conclusions about population

Random sampling in probability samples

- Removes the possibility of bias in selection of subjects
- Ensures that each subject has a known probability of being chosen
- Allows application of statistical theory

Sampling error

- No sample is a perfect mirror image of the population
- Magnitude of error can be measured in probability samples
- Expressed by standard error of mean, proportion, differences…
- Function of:
  - Sample size
  - Variability in measurement

Methods used in probability samples

1. Simple random sampling
2. Systematic sampling
3. Stratified sampling
4. Cluster sampling
5. Multistage sampling

1. Simple random sampling

- Principle
  - Equal chance for each sampling unit
- Procedure
  - Number all units
  - Randomly draw units
- Advantages
  - Simple
  - Sampling error easily measured
- Disadvantages
  - Need complete list of units
  - Does not always achieve best representation

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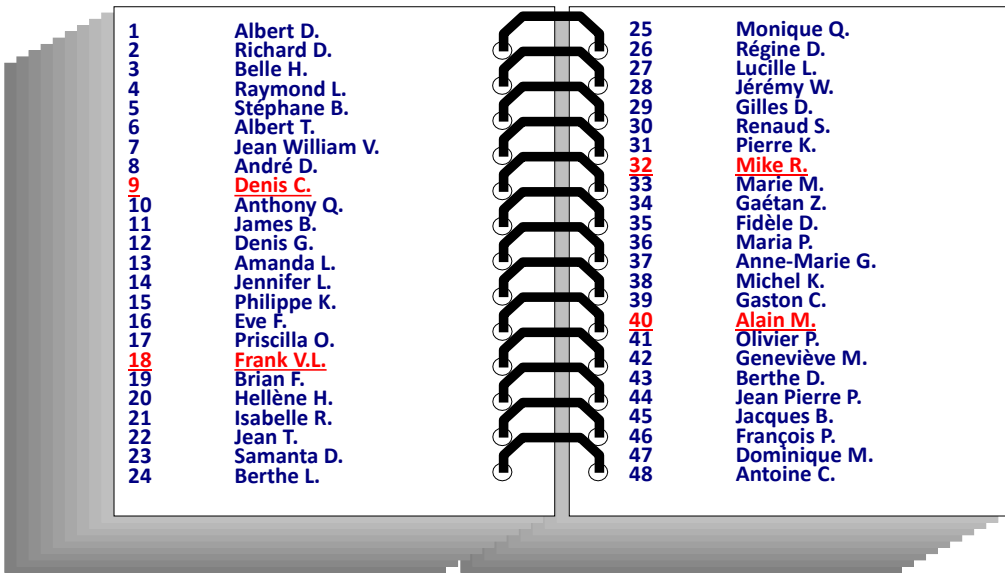
Example of simple random sampling

Numbers are selected at random



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2. Systematic sampling

- Principle
  - A unit drawn every k units
  - Equal chance of being drawn for each unit
- Procedure
  - Calculate sampling interval (k = N/n)
  - Draw a random number ($\leq$ k) for starting
  - Draw every k units from first unit
- Advantages
  - Ensures representativity across list
  - Easy to implement
- Disadvantage
  - Dangerous if list has cycles

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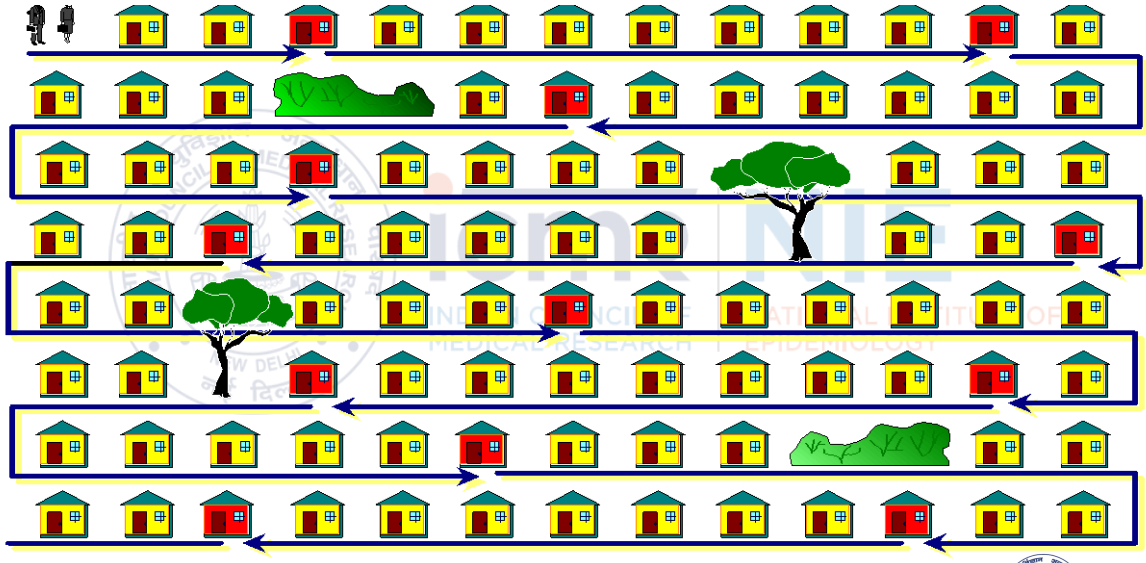
Example of systematic sampling



Every eighth house is selected

3. Stratified sampling

- Principle
  - Classify population into homogeneous subgroups (strata)
  - Draw sample in each strata
  - Combine results of all strata
- Advantage
  - More precise if variable associated with strata
  - All subgroups represented, allowing separate conclusions about each of them
- Disadvantages
  - Sampling error difficult to measure
  - Loss of precision if small numbers sampled in individual strata

Example of stratified sampling

- Estimate vaccination coverage in a country
- One sample drawn in each region
- Estimates calculated for each stratum
- Each strata weighted to obtain estimate for country

4. Cluster sampling

- Principle
  - Random sample of groups ("clusters") of units
  - All or proportion of units included selected clusters
- Advantages
  - Simple: No list of units required
  - Less travel/resources required
- Disadvantages
  - Imprecise if clusters homogeneous (Large design effect)
  - Sampling error difficult to measure

Cluster sampling

- The sampling unit is not a subject, but a group (cluster) of subjects.
- It is assumed that:
  - The variability among clusters is minimal
  - The variability within each cluster is what is observed in the general population

The two stages of a cluster sample

1. First stage: *Probability proportional to size*
   - Select the number of clusters to be included
   - Compute a cumulative list of the populations in each unit with a grand total
   - Divide the grand total by the number of clusters and obtain the sampling interval
   - Choose a random number and identify the first cluster
   - Add the sampling interval and identify the second cluster
   - By repeating the same procedure, identify all the clusters
2. Second stage
   - In each cluster select a random sample using a sampling frame of subjects (e.g. residents) or households

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5. Multistage sampling

- Principle
  - Several chained samples
  - Several statistical units
- Advantages
  - No complete listing of population required
  - Most feasible approach for large populations
- Disadvantages
  - Several sampling lists
  - Sampling error difficult to measure

Key issues

- We cannot study the whole population so we sample it
- Taking a sample leads to sampling error, which is measurable
- Good design and quality assurance ensure validity and while appropriate sample size will ensure precision
- Probability samples are the only one that allow use of statistics as we know them

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Thank you