Sampling & Sample Size Estimation

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Topics to be covered

- Introduction: History of Sampling
- What is Sampling and Why Sample?
- Core Concepts & Terminology
- Sampling Methods: Probability vs. Non-Probability
- Probability Sampling (In Detail)
- Non-Probability Sampling (In Detail)
- Errors in Sampling
- Determining Sample Size
- Pre-Fieldwork Checklist
- Summary & Q&A

History of Sampling

The Literary Digest Poll of 1936

- *The Literary Digest* successfully predicted U.S. presidential elections from 1920 to 1932.
- **1936 Poll:** They sent out **10 million** mock ballots.
- Sample drawn from **automobile registration lists** and **telephone directories**.
- **Prediction:** Alf Landon would defeat Franklin D. Roosevelt by a landslide.
- **Actual result:** Roosevelt won by a landslide.
- **Why?** In 1936, owning a car or phone was a sign of wealth – the sampling frame did **not** represent all voters.
- **Lesson:** A huge sample is worthless if it is not representative.

What is sampling

- **Sample:** A subset of a larger body (the population) selected to represent the whole.
- **Sampling:** The process of choosing that subset.
- **Census:** A survey that collects data from *every* member of the population.
- **Key point:** Sampling is a practical, cost-effective way to learn about a population.

Why Sample?
(Advantages over a Census)

- **Cost-effective** – much cheaper than a census.
- **Time-efficient** – results are available faster.
- **Practical** – often logistically impossible to reach everyone.
- **Potentially more accurate** – a well-designed sample allows better quality control (e.g., better interviewer training, more thorough follow-up).
- *Example:* Gallup poll uses **~1,500** respondents to be **95% confident** within **±3 percentage points**.

Population and sample

•**Population (Target Population):** The entire group of interest.
(e.g., all adults ≥65 years in Myanmar)

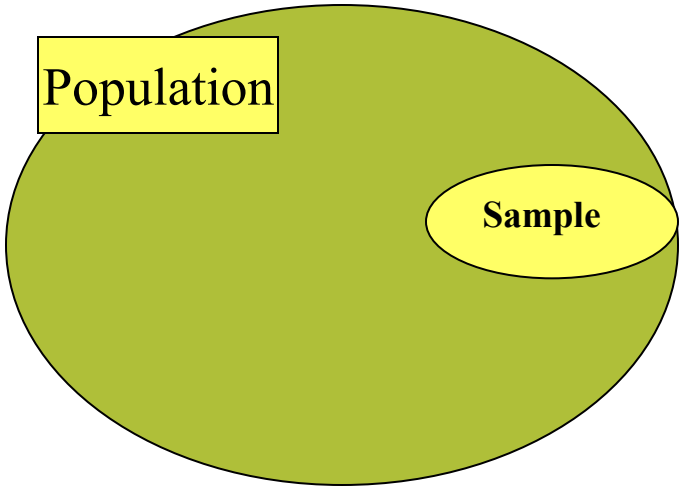
•**Sample:** The subset from which you collect data.

•**Parameter:** A numeric summary of the *population*.
(e.g., average age of all elderly in Myanmar)

•**Statistic:** A numeric summary of the *sample*.
(e.g., average age of your sample)

•**Sampling Unit:** The element being sampled (e.g., individual, household).

•**Sampling Frame:** A list (or mechanism) from which you draw the sample (e.g., voter registry, telephone directory).



A Census

- A survey in which information is gathered about all members of a population
- Gallup poll is able to develop representative samples of any adult population with interviews of approximately 1500 respondents
- That sample size allows them to be 95% confident that the results they obtain are accurate within + or – 3% points

Sampling concepts and terminologies

- Population/Target population
- Sampling unit
- Sampling frame

Population/Target Population

- *Target Population* is the collection of all individuals, families, groups organizations or events that we are interested in finding out about.

- Is the population to which the researcher would like to generalize the results. For example, all adults population of Myanmar aged 65 or older

Sampling unit/Element/ Unit of analysis

- Sampling unit is the unit about which information is collected.
- Unit of analysis is the unit that provides the basis of analysis.
- Each member of a population is an element. (e.g. a child under 5)
- Sometimes it is household, e.g. any injury in the household in the last three months.

Sampling Frame

- The actual list of sampling units from which the sample, or some stage of the sample, is collected
- It is simply a list of the study population

Sample Design

- A set of rules or procedures that specify how a sample is to be selected
- This can either be probability or non-probability
- Sample size: The number of elements in the obtained sample

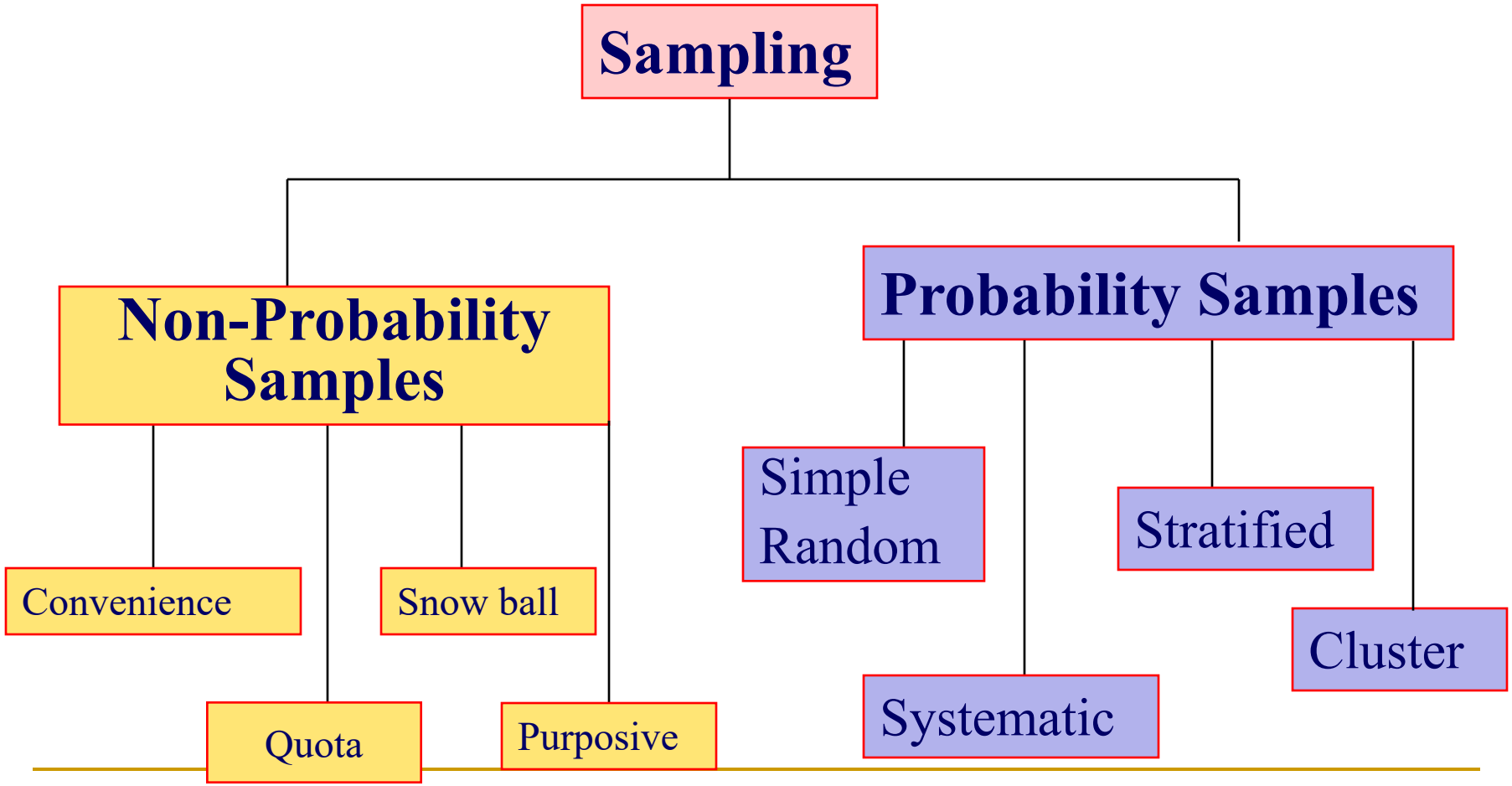
Types of sampling

Types of sampling

- There are two types of sampling techniques:

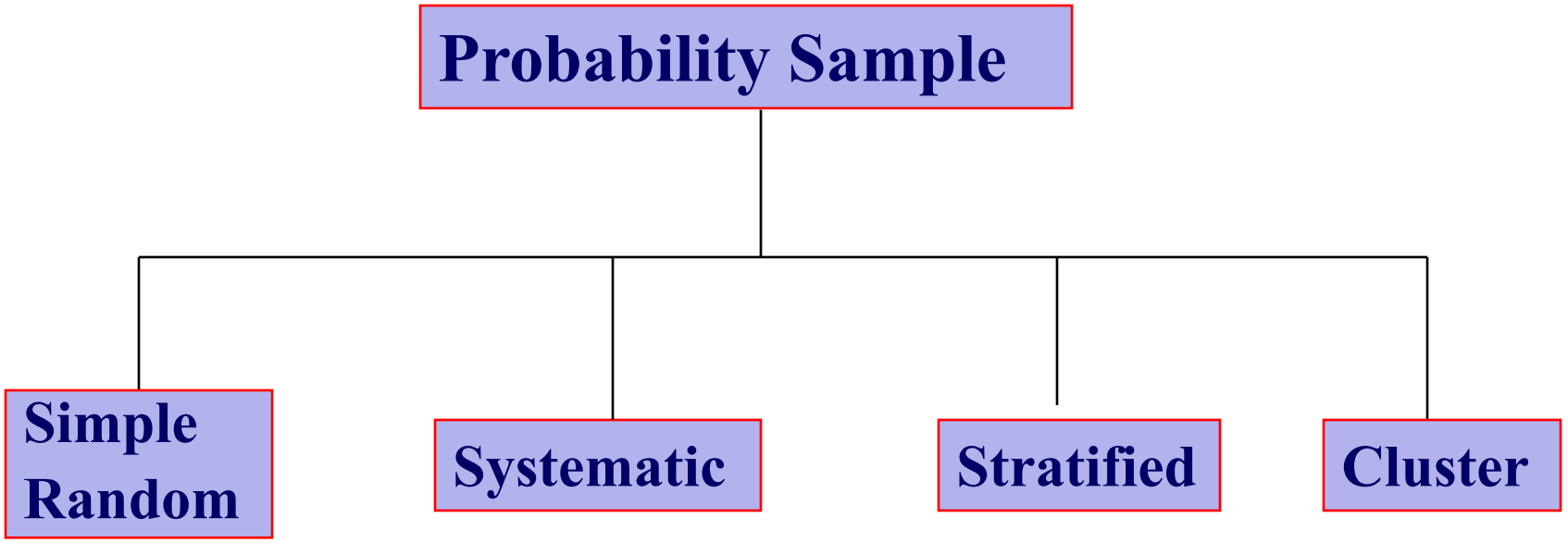
- Probability sampling (or Random)
- Non- Probability sampling (or non-Random)

Types of Sampling Methods



Probability Sampling

- This is one in which each person in the population has a chance/probability of being selected



Types of Probability Sampling

- Simple random
- Systematic sampling
- Stratified random
- Cluster sampling
- Multi-stage sampling

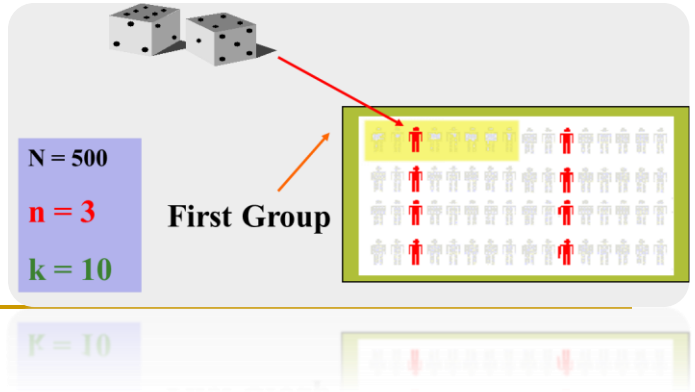
Simple Random Sampling

- Every individual in the sampling frame has an **equal chance** of being selected.
- Selection via random number generators or tables.
- **Advantages:** Unbiased; representative on average.
- **Disadvantages:** Requires a complete sampling frame; can be impractical for large populations.

Systematic sample

- Select subjects at regular intervals from a **randomised list**.
- **Steps:**
  - Number all units.
  - Calculate interval k = Population size / Sample size.
  - Randomly choose a starting point between 1 and k.
  - Select every k-th unit thereafter.

- **Example:** 10% sample from 5,000 → k=10, start at 3 → select 3, 13, 23, …
- **Advantage:** Easier than simple random sampling.

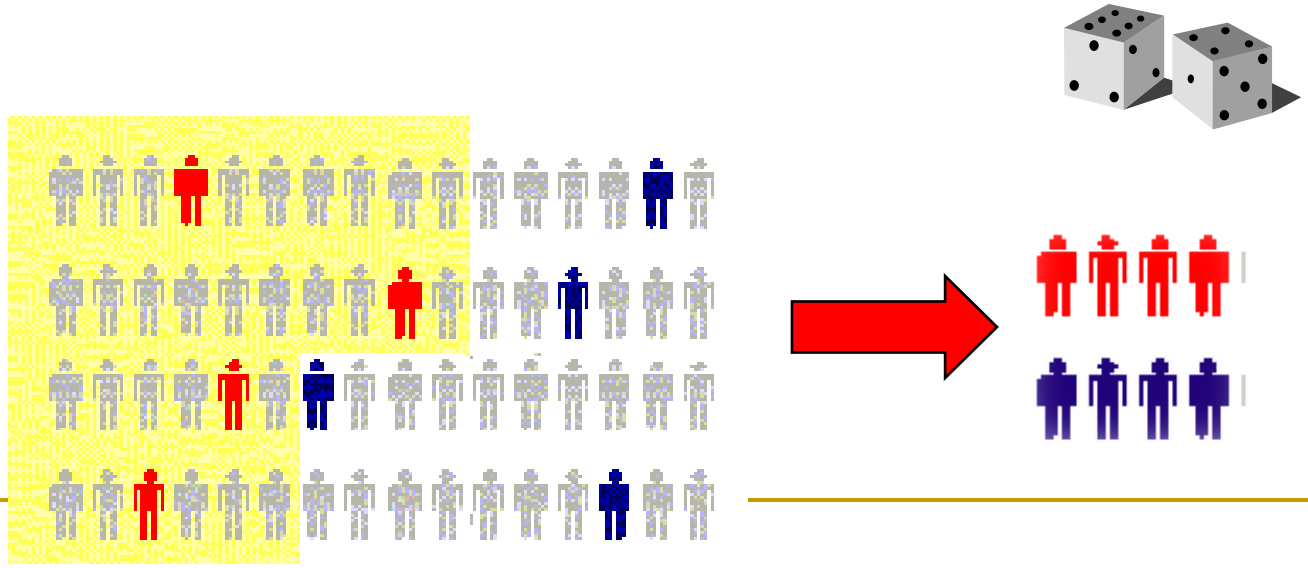


Stratified Random sample

- Divide population into distinct **strata** based on key characteristics (e.g., gender, age, SES).
- Draw a **simple random sample** from each stratum.
- Combine the samples.
- **Why use it?**
  - Guarantees representation of small subgroups.
  - Increases overall precision.
- **Example:** Population is 60% female / 40% male → randomly select 60 women and 40 men.

Stratified Samples

- Procedure: Divide the population into strata (mutually exclusive classes), such as men and women. Then randomly sample within strata.
- Suppose a population is 30% male and 70% female. To get a sample of 100 people, we randomly choose males (from the population of all males) and, separately, choose females. Our sample is then guaranteed to have exactly the correct proportion of sexes.

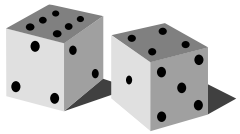


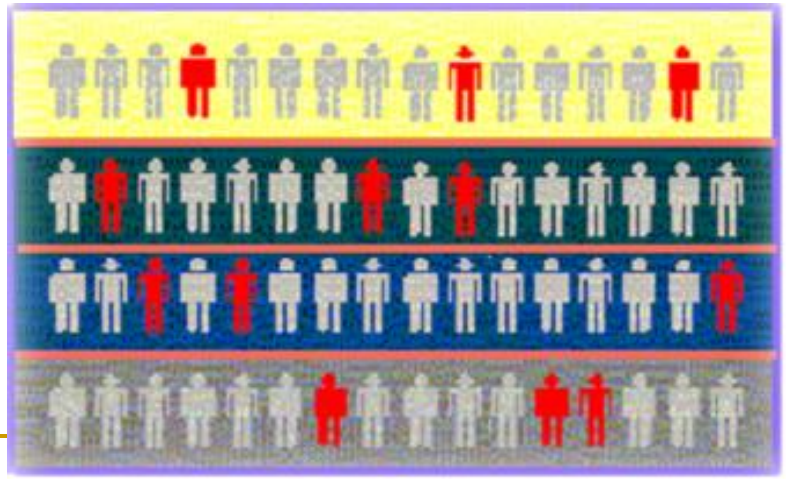
Cluster sample

- Divide population into natural groups (clusters) – e.g., city blocks, schools, hospitals.
- Randomly select a subset of clusters.
- Include **all** members (or a random subset) from selected clusters.
- **Why use it?**
  - Very cost-effective for geographically dispersed populations.
  - Useful when no complete list of individuals exists.
- **Example:** To survey nurses nationwide, randomly pick 20 hospitals and survey all nurses within them.

Cluster Samples

- Population divided into several “clusters,” each representative of the population
- Simple random sample selected from each
- The samples are combined into one





Population divided into 4 clusters.

Non- Probability Sampling /(Non-Random)

The probability of inclusion is unknown.

- **Convenience:** Who is easiest to reach (e.g., street interviews). Prone to bias – avoid if possible.
- **Purposive (Judgment):** Researcher selects “typical” or informative cases. Useful for qualitative/exploratory work.
- **Quota:** Pre-set quotas for subgroups, but selection is **not** random. Better than convenience, but still not representative.
- **Snowball:** Existing participants recruit others from their network. Ideal for “hidden” populations (e.g., drug users).

Convenience Sample

- Man-in-the-street surveys and a survey of blood pressure among volunteers who drop in at an examination booth in public places are in the category.

- If you have a choice, don't use this method. Often produces really wrong answers, because certain attributes tend to cluster with certain geographic and temporal variables.
  - For example, at 8am in Tokyo, most of the people on the street are workers heading for their jobs.
  - At 10am, there are many more people who don't work, and the proportion of women is much higher.
  - At midnight, there are young people and muggers.

Quota

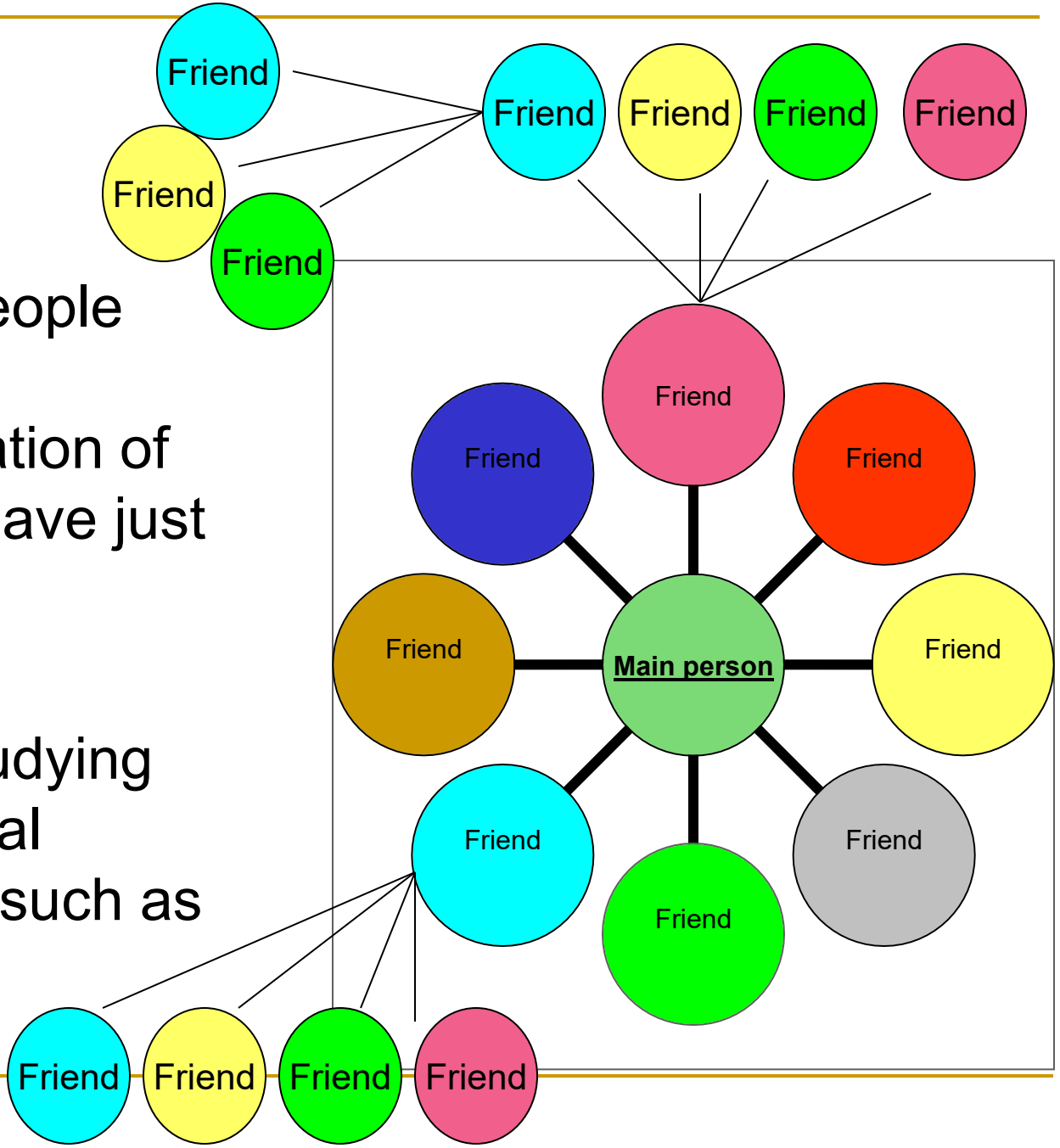
- Haphazard sampling within categories
- Is an improvement on convenience sampling, but still has problems.
- How do you know which categories are key?
- How many do you get of each category?

Purposive/Judgment

- Selecting sample on the basis of knowledge of the research problem to allow selection of appropriate persons for inclusion in the sample
- Expert judgment picks useful cases for study
- Good for exploratory, qualitative work, and for pre-testing a questionnaire.

Snowball

- Recruiting people based on recommendation of people you have just interviewed
- Useful for studying invisible/illegal populations, such as drug addicts



Non-sampling Errors

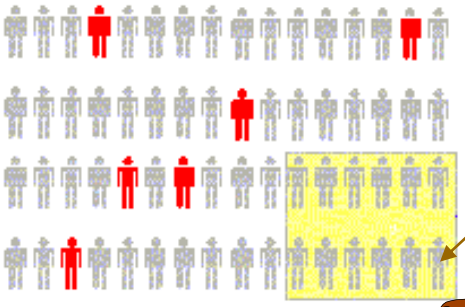
- An inadequate sampling frame (Non-coverage)
- Non-response from participants
- Response errors
- Coding and data entry errors

Types of Survey Errors

•**Sampling Error:** The natural difference between sample statistic and population parameter – decreases with larger sample.

•**Non-Sampling Errors (often more serious):**

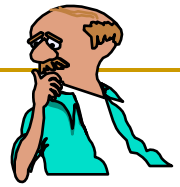
- **Coverage Error:** The sampling frame does not cover the target population.
  (Solution: use a complete frame.)
- **Non-Response Error:** Selected individuals do not participate.
  (Solution: follow-up with non-respondents.)
- **Measurement Error:** Flawed questions or data collection.
  (Solution: pre-test and train interviewers.)
- **Data Processing Error:** Mistakes in coding/entry.
  (Solution: implement validation checks.)



Excluded from frame.

Follow up on non responses.

Chance differences from sample to sample.

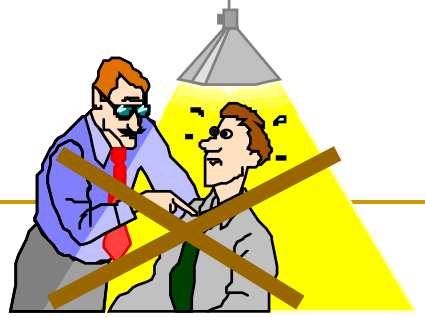


Bad Question!

Improving Response Rates

Methods of Improving Response Rates

- **Reducing Refusals**
  - **Prior Notification**
  - **Motivating Respondents**
  - **Incentives**
  - **Questionnaire Design and Administration**
  - **Follow-Up**
  - **Other Facilitators**
- **Reducing Not-at-Homes**
  - **Callbacks**



Evaluating Survey Worthiness

- What is the purpose of the survey?
- Is the survey based on a probability sample?
- Coverage error – appropriate frame
- Non-response error – follow up
- Measurement error – good questions elicit good responses
- Sampling error – always exists

Sample size estimation

Sample Size

- Sample size relates to how many people to pick up for the study
- The question often asked is: How big a sample is necessary for a good survey?
- The main objective is to obtain both a desirable accuracy and a desirable confidence level with minimum cost.

Determination of Sample Size

- Type of analysis to be employed
- The level of precision needed
- Population homogeneity /heterogeneity
- Available resources
- Sampling technique used

Sample Size Calculation

$$n = \frac{z^2 p\, q}{d^2}$$

- ***n:*** the desired sample size
- ***z:*** the standard normal deviate usually set at 1.96 (which corresponds to the 95% confidence level)
- ***p:*** the proportion in the target population to have a specific characteristic. If no estimate available set at 50% (or 0.50)
- ***q:****1-p*
- ***d:*** absolute precision or accuracy, normally set at 0.05.

Key factors to consider:

- Population heterogeneity (more diverse → larger sample)
- Desired precision (margin of error, d)
- Confidence level (usually 95%, z=1.96)
- Type of analysis (subgroup analyses require larger n)
- Available resources (budget, time)
- **Formula for a proportion (cross-sectional study):**
- $n = \frac{z^2 \times p \times q}{d^2}$
- p = estimated proportion (use 0.5 if unknown)
- q = 1 - p
- d = desired margin of error (e.g., 0.05)

Given: No estimate for p → use 0.5.

z = 1.96 (for 95% confidence), d = 0.05

$$n = \frac{(1.96)^2 \times (0.5) \times (0.5)}{(0.05)^2} = \frac{3.84 \times 0.25}{0.0025} = 384$$

Result: A minimum sample of **384** is needed for a large population.

Note: Adjust for finite population correction if the population is small.

Pre-Fieldwork Checklist…

- Before you go to the field, ensure:
- Work plan with clear timelines
- Field logistics finalised (travel, accommodations)
- Financing and budget secured
- Data collection instruments developed
- Training manual for field staff prepared
- Pilot test conducted and lessons incorporated

Summary

- **Sampling** is essential for practical, cost-effective research.
- A good **sampling frame** is critical to avoid coverage errors.
- **Probability sampling** is the gold standard for generalisable quantitative studies.
- **Non-probability sampling** is useful for qualitative or hard-to-reach populations.
- **Sample size** balances precision, confidence, and resources.
- **Non-sampling errors** often outweigh sampling errors – plan to minimise them.

Thank you