A guide to choosing sample sizes for M&E practitioners

27 May 2021

ActivityInfo

Learning objectives

- Choose a sample size for:
  - Snapshots: a KAP or Needs Assessment survey
  - Change over time: a baseline/final surveys
- Account for costs for stratified and clustered samples

Learning objectives: Key concepts

- Population
- Sample
- Sampling method
- Sample estimate
- Population parameter
- Error
- Sampling error
- Non-sampling error
- Population standard deviation
- Sample standard deviation
- Effect size
- Type 1 and Type 2 Error
- Simple Random Sample
- Complex Sample
- Intra-cluster Correlation Coefficient
- Design Effect

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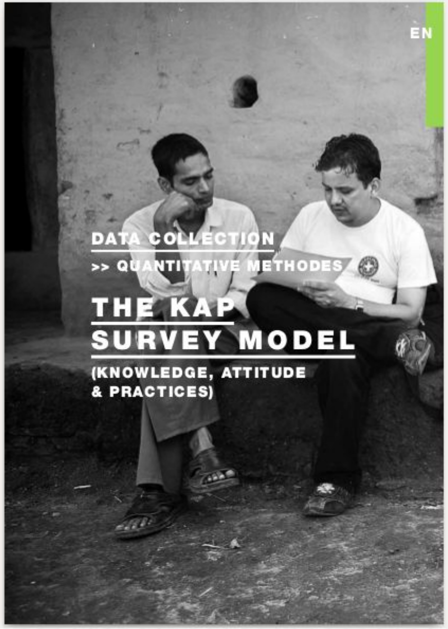
Samples sizes for **KAP Surveys** and **Needs Assessments**

Knowledge Attitude and Practices (KAP)

Provide a quantitative **snapshot** of the knowledge, attitudes, and practices of a population.

Results can be used to design interventions.



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For more information:
https://www.medecinsdumonde.org/en/actualites/publications/2012/02/20/kap-survey-model-knowledge-attitude-and-practices

KAP survey example

Goal: Increase COVID-19 vaccination rates in a rural population

KAP Survey:

- Only 15% of respondents knew that the vaccine was available for free
- 5% of respondents said they could not afford to travel to the vaccination site.

Conclusion: focusing on awareness raising will have a high impact on vaccination rates (because …)

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KAP survey example

Goal: Increase COVID-19 vaccination rates in a rural population

KAP Survey:

- 95% of respondents knew that the vaccine was available for free
- 50% of respondents said they could not afford to travel to the vaccination site.

Conclusion: funding mobile vaccination sites will increase vaccination rates

Needs assessment surveys

Provide a quantitative **snapshot** of the needs of a large population.

Results can be used to **design** interventions to address the most pressing vulnerabilities.

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Needs assessments: Example

Goal: Reduce morbidity and mortality and preserve dignity among a large group of newly-displaced IDPs.

Needs assessment:

- What % have adequate shelter?
- What % experienced diarrhea in last 7 days?

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Key concepts

Population is the entire group of people* about whom we want to draw conclusions.

A **sample** is the specific group that you will collect data from.

The **sampling method** is the process of choosing which members of the population are included in the sample.

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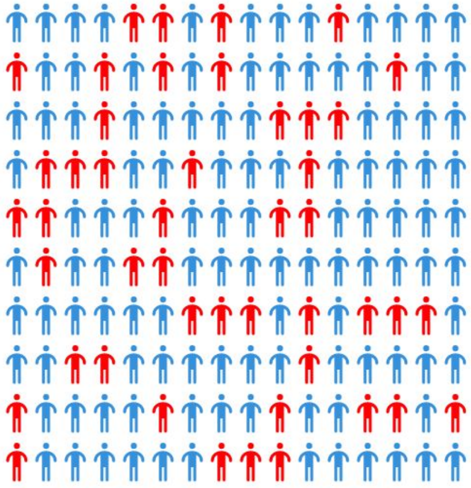
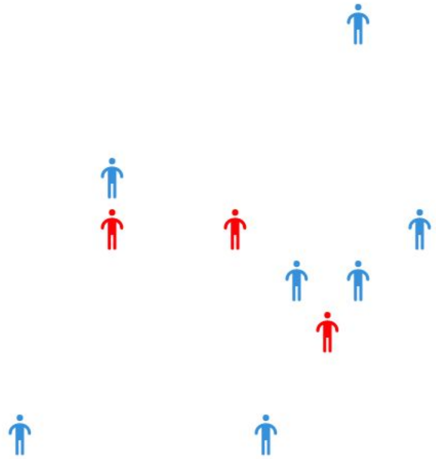
Key concepts - applied to IDP Needs Assessment

Population is the entire 20,000 IDP **households** about which we are concerned.

A **sample** is the specific 200 households we will interview.





How can draw conclusions about a **population** of 20,000 households based on a **sample** of 200 households ??

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Key concepts: Estimates and Error

The **Sample estimate** is the result we get from our survey.

Error is the difference between our **sample estimate** and the **population parameter**, or the “true” value.

Key concepts: Applied

Population parameter: 7% of households had at least one case of diarrhea in last 7 days.

Sample estimate: 15% of responding households had at least one case of diarrhea in last 7 days.

Error	=	Population parameter - Sample Estimate
	=	7% - 15%
	=	-8%

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Key concepts: Types of Error

Sampling Error

Error resulting from the difference between the population and our sample.

Can be estimated using mathematics.

Non-Sampling Errors

Other error, not related to sampling, including:

- Non-response error
- Interviewer error
- Social desirability bias

Difficult or impossible to estimate non-sampling error using mathematics.

Probability theory: example

If the probability of flipping a coin and getting “heads” is ½, then what is the probability of getting three heads in a row?

P(3 heads) = ½ × ½ × ½ = ⅛ = 12%

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~~How can we draw conclusions about a **population** of 20,000 households based on a **sample** of 200??~~

What is the probability of getting a **sample estimate** that has an **error** of 10% or more compared to the population value?

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Probability theory

Sampling error can be estimated using tools from **probability theory**, a branch of mathematics.

Probability theory gives us tools to estimate how likely or unlikely events are.

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Sampling error

Sampling error ($\sigma_{\bar{x}}$) depends on:

- Sample size (n)
- Population size (N)
- Population std. deviation (σ)
- Confidence level ($t_{\alpha/2}$)
- Sample design*

$$\sigma_{\bar{x}} = t_{\alpha/2} \frac{\sigma}{\sqrt{n}} \sqrt{\frac{N - n}{N - 1}}$$

Don't panic!
We have a
calculator

Calculating required sample size

If we know:

- Population size (*N*)
- Population std. deviation (σ)

$$t_{\alpha/2} \frac{\sigma}{\sqrt{n}} \sqrt{\frac{N - n}{N - 1}}$$

And we choose:

- Confidence level ($t_{\alpha/2}$) and Sampling error ($\sigma_{\bar{x}}$)

We can solve for Sample Size (n) algebraically

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Population standard deviation

- Measure of how diverse or how much variance there is in the population in our measurement

=> The more diversity, the larger a sample we need.

- Estimate using the **Sample Standard Deviation** (s)

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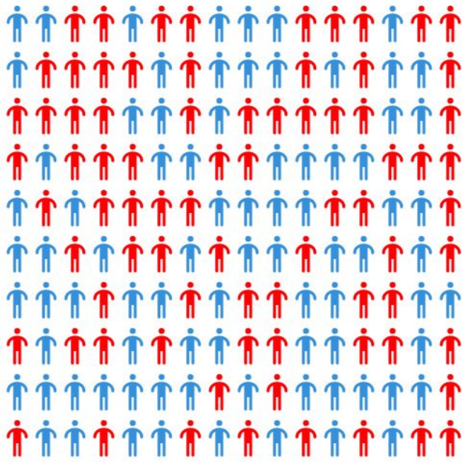
Standard deviation - Percentages

Formula: $s = (p)(1-p)$ Where p is the percentage as a fraction

10% had diarrhea
s = (.10)(.90) = .09
Low stdev



50% had diarrhea
s = (.5)(.5) = .25
Highest stdev

90% had diarrhea
s = (.90)(.10) = .09
Low stdev

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Examples: percentages

- **Gender:** usually split 50/50% (high standard deviation). We will need a larger sample to measure % of women precisely.

- **Left-handed:** about 10% (low standard deviation). We can use a smaller sample.

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Standard deviation strategies

No information

Plan for the largest standard deviation to be safe.

Information available

Use previous surveys, census, etc, to estimate and save resources by planning for a smaller sample.

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Recap: Calculating required sample size

If we know:

- ~~Population size (N)~~
- ~~Population std. deviation (σ)~~

$$t_{\alpha/2} \frac{\sigma}{\sqrt{n}} \sqrt{\frac{N - n}{N - 1}}$$

And we choose:

- Confidence level ($t_{\alpha/2}$)
- Sampling error ($\sigma_{\bar{x}}$)

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Sampling Error

Often communicated as:

- **Margin of error:** 25% ± 5% of IDPs have access to shelter.
- **Confidence intervals:** 20% - 30% of IDPs have access to shelter.

You should think of surveys as giving a **range** rather than an exact result.

Revisited: KAP survey example

Goal: Increase COVID-19 vaccination rates in a rural population

KAP Survey:

- Only 15% of respondents knew that the vaccine was available for free
- 5% of respondents said they could not afford to travel to the vaccination site.

Conclusion: focusing on awareness raising will have a high impact on vaccination rates

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Revisited: KAP survey example

Goal: Increase COVID-19 vaccination rates in a rural population

KAP Survey: ± 5%

- Between 10% and 20% of the population knows that the vaccine was available for free
- Between 0 and 10% of population cannot afford to travel to the vaccination site.

Still valid?

Conclusion: focusing on awareness raising will have a high impact on vaccination rates

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Revisited: KAP survey example

Goal: Increase COVID-19 vaccination rates in a rural population

KAP Survey:

± 10%

- Between 5% and 25% of the population knows that the vaccine was available for free
- Between 0 and 15% of population cannot afford to travel to the vaccination site.

Still valid?

Conclusion: focusing on awareness raising will have a high impact on vaccination rates

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Revisited: KAP survey example

Goal: Increase COVID-19 vaccination rates in a rural population

KAP Survey: ± 20%

- Between 0% and 35% of the population knows that the vaccine was available for free
- Between 0 and 25% of population cannot afford to travel to the vaccination site.

Conclusion: focusing on awareness raising will have a high impact on vaccination rates

Still valid?

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Using the calculator

https://www.activityinfo.org/support/docs/sampling/index.html

Samples sizes for **Comparisons**

Example

Program: Three year program to increase women's meaningful participation in the security sector in a Middle Income Country (MIC)

Indicator: Percentage of security sector staff holding a positive perception of women's entry, advancement and leadership in the security sector.

Population: All persons employed on January 1st, 2018 in the Army, Navy, or Police.

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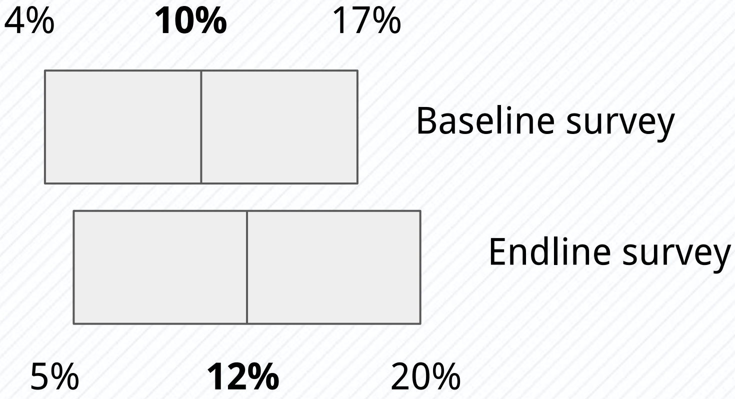
Measuring impact

Baseline survey, final survey after 3 years.

How large of a sample do we need?

Confidence intervals, n = 100



Probability theory gives us the tools to estimate the difference in percentages:

Difference is between -10% and +6%

Key concepts: Effect size

Effect size the magnitude of difference between populations.

$$ES = \frac{p_1 - p_0}{\sqrt{p_1(1-p_1)}}$$

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Key concepts

Type 1 Error: False positive. Survey says there is a difference, but there is not in reality.

Type 2 Error: False negative: Survey says there is no difference, but there is a difference in reality.

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Measuring impact

Baseline survey, final survey after 3 years.

How large of a sample do we need?

What is the smallest change we want to reliably detect?

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Using the sample calculator

https://www.activityinfo.org/support/docs/sampling/baseline-and-endline.html

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Accounting for **Sample Design**

Key concepts

The **sampling method** is the process of choosing which members of the population are included in the sample

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Key concepts - sampling methods

Random sampling

Sample is selected randomly, without bias.

Every member of the population has a well-defined probability of being selected.

Error and design effect can be estimated mathematically.

Convenience Sampling

Sample is selected at the interviewer or respondent's convenience.

Examples: Interviewing people in the market, web surveys on social media.

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Key concepts - random samples

Simple Random Sample (SRS)

Every member of the population has an **equal** and **independent** chance of being selected.

Complex Sample

Every member of the population has a **known chance** of being selected.

Design includes:

- Stratification
- Clustering
- Multiple stages

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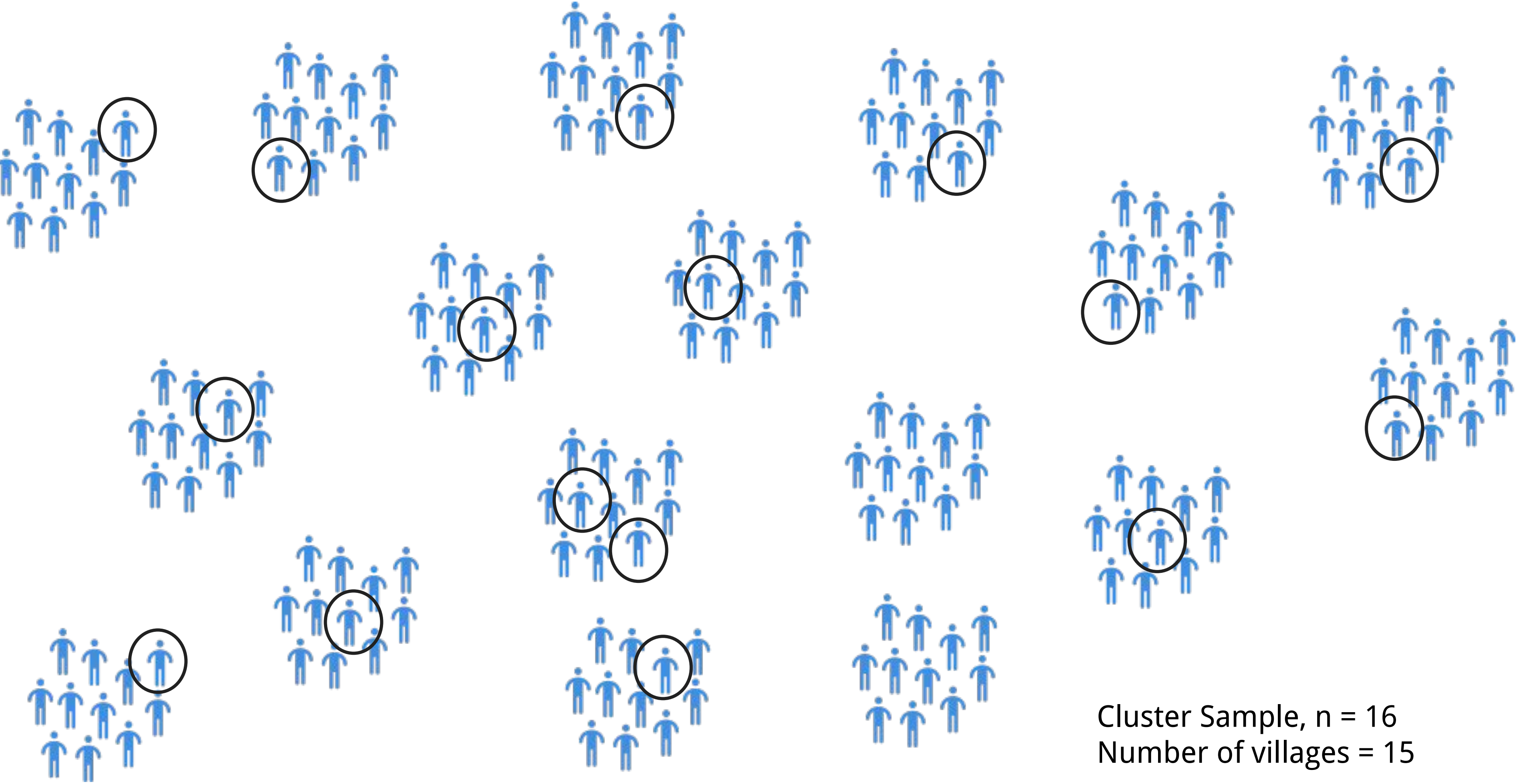
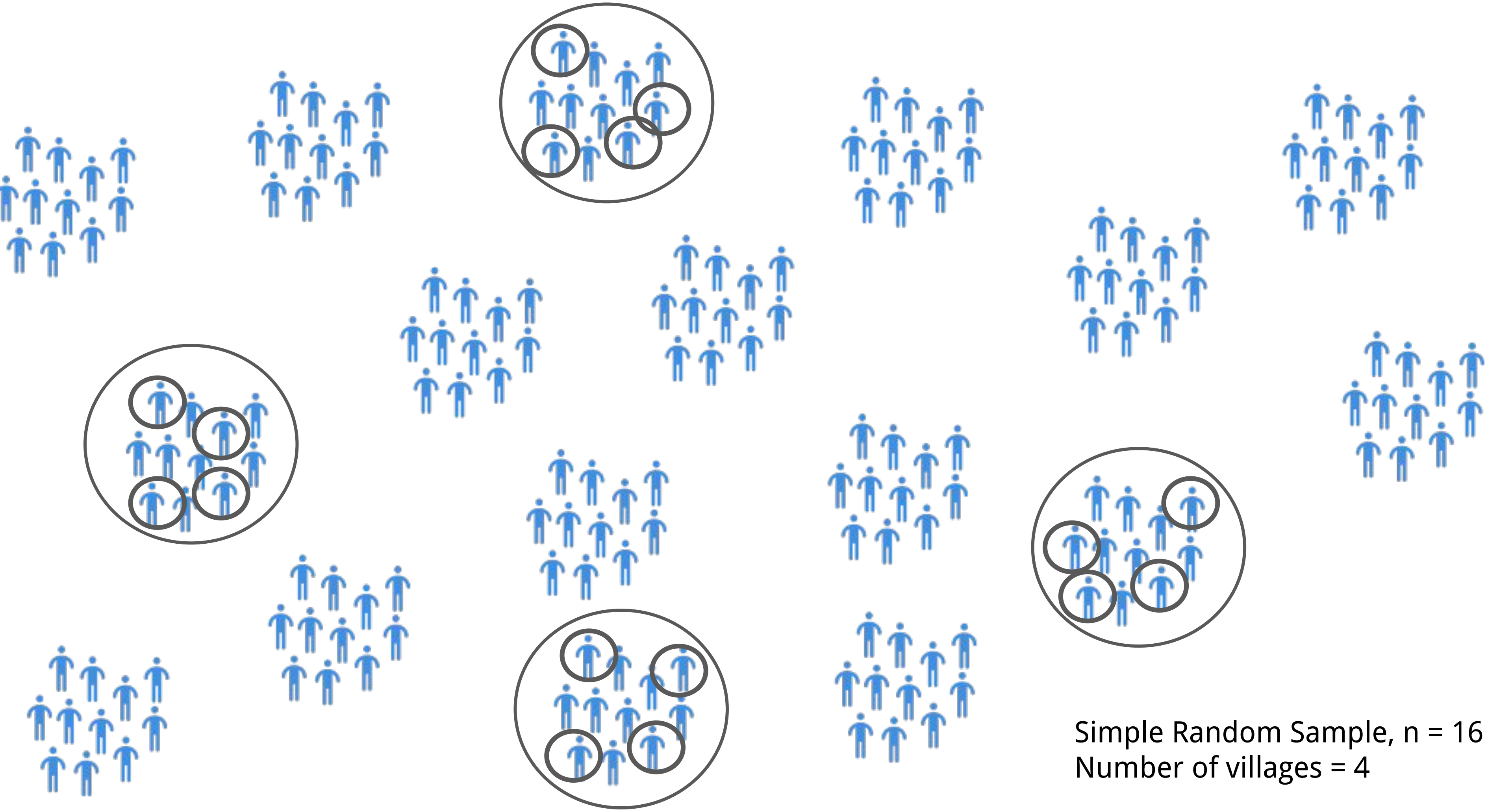
Problem: transportation costs

If we select a SRS, we might have to travel to a many different places.



Cluster Sample, n = 16
Number of villages = 15


Simple Random Sample, n = 16
Number of villages = 4

Cluster sampling

- First select clusters randomly
- Then select individuals within the cluster randomly
- Sample is no longer **independently** selected

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Key concepts

Intra-cluster correlation (ICC): The degree to which members of the same cluster resemble each other.

Effective sample size: the sample size of a Simple Random Sample (SRS) with the same precision.

Design effect: The ratio between the actual sample size and the effective sample size.

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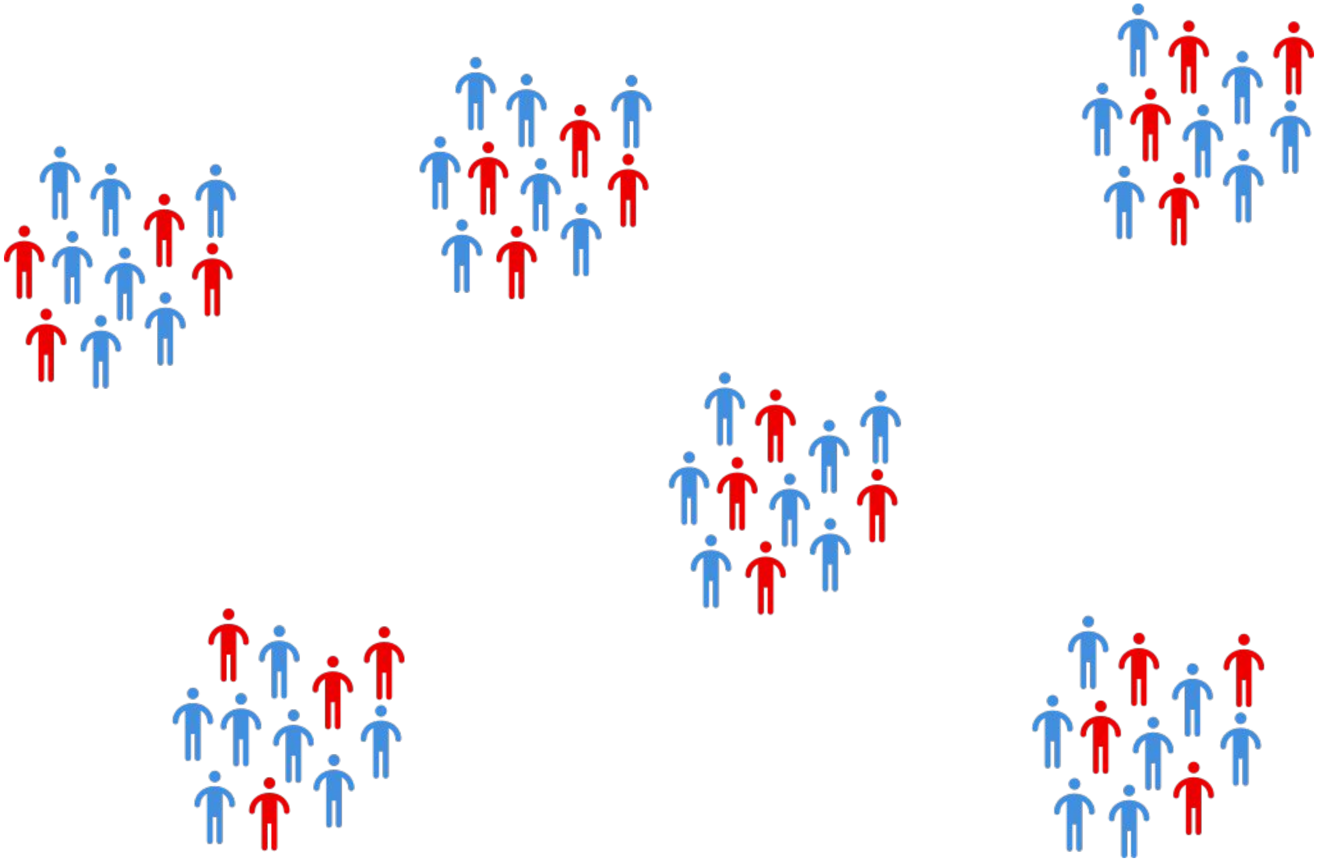
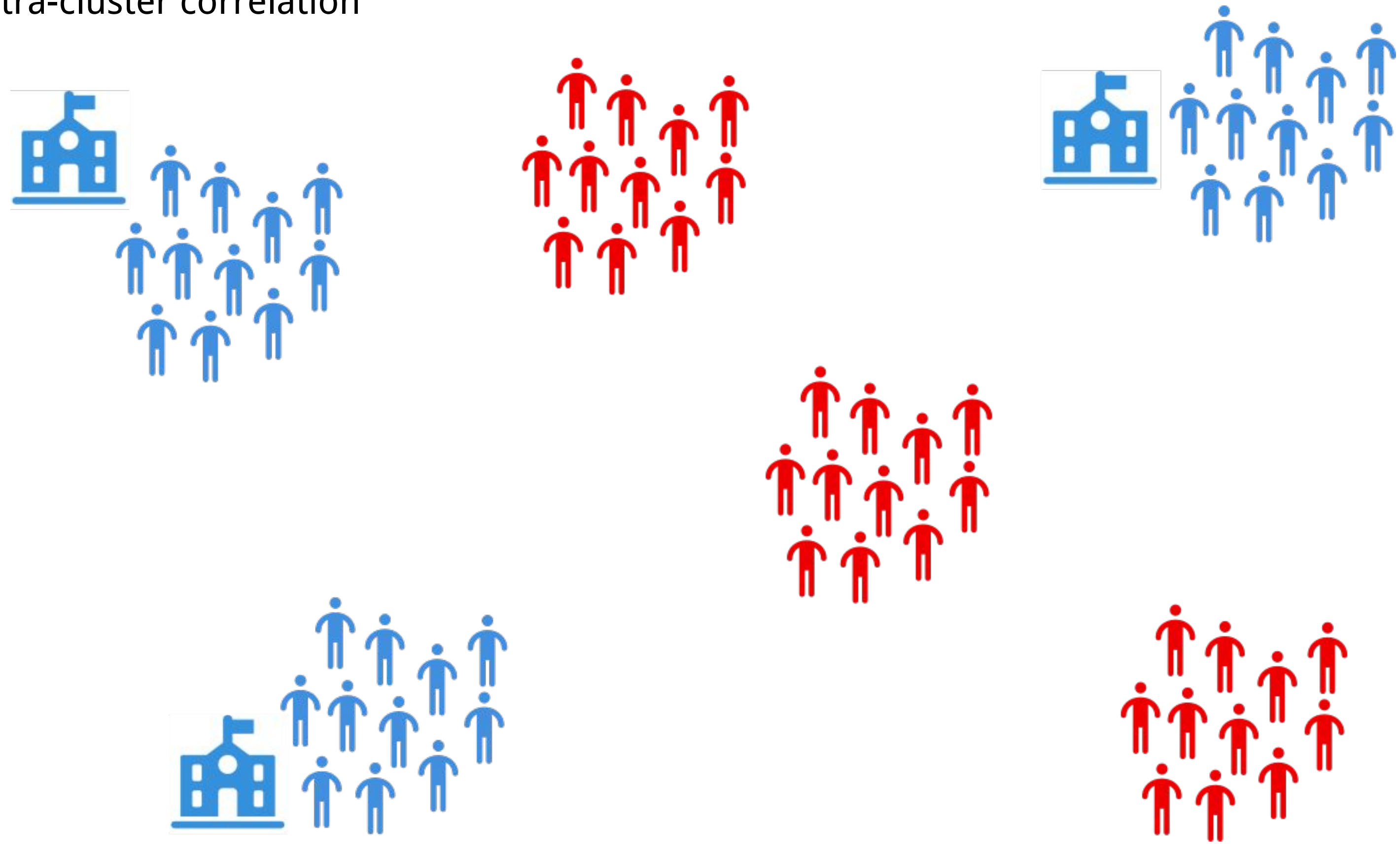
Example: % of population under 25
Low intra-cluster correlation



Example: % of population with access to an elementary school
Very high intra-cluster correlation



Using Design Effect

If you are planning on a survey with a Design Effect of 2.0, **double** your required sample size.

If you are planning on a survey with a Design Effect of 3.0, **triple** your required sample size.

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Using the ICC and Design Effect Calculator

https://www.activityinfo.org/support/docs/sampling/cluster.html

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Thank you!
Please try
www.activityinfo.org
and join us for our next webinar!