Statistical Survey Techniques

Basic Theory of Sampling Survey and Non-Sampling Error

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Need For Agricultural Statistics

1. Commodity situation and out look analysis,
2. Policy alternatives,
3. National and regional planning,
4. Monitoring and evaluation

Facts

"Before number can be used for good or evil, we must collect them, anyway."

Source of Data

1. Experimental Data

   • To obtain on the basis of well-designed and controlled statistical experiments.

2. Survey Data

   2.1 Complete Enumeration

   • Selecting and collecting data from every unit in the population.

   2.2 Sample Survey

   • Selecting and collecting data from a portion of units of the population.

Source of Data (Cont.)

2.2 Sample Survey (Cont.)

a) Non-Probability Sampling

- Purposive Sampling
- Quota Sampling

b) Probability Sampling

– Each unit is selected in the sample with a known probability.

– It provides a sample that is expected to be representative of the population.

– It provides the capability of estimation.

Source of Data (Cont.)

3. Administrative Data

- To obtain data from administrative activities such as registration and licensing.

4. Geo- Information Technique

- RS, GIS, and GPS Technique, uses satellite data for producing agricultural statistics and agricultural resources maps.

Note: RS => Remote Sensing

GIS=> Geographic Information System

GPS=> Global Positioning System

Source of Data (Cont.)

4. Geo- Information Technique (Cont.)

- The methodology comprises:
  - Satellite image interpretation.
  - Ground truth investigation.
  - Accurate assessment by using random sampling and Geo–Positioning System.

Quality of Data

1. Timeliness
2. Accuracy
3. Relevance
4. Completeness
5. Continuity

Data Collecting Method

1. Interview
    - Personal Interview
    - Telephone Interview
2. Self- administered (Mailed) Questionnaire
3. Physical observation or direct measurement
4. Book- keeping
5. Transcription from record

Advantages of the Sampling Method

1. Is it the objective to get the data for each and every unit , or for groups of unit?

2. Is it necessary to obtain exact information, that is, without error, for the purpose in view?

3. Does a complete enumeration survey always provide us with accurate information?

Sampling Versus Census

1. Reduced cost
2. Reduced time
3. Greater scope
4. Greater accuracy

Technical Terms

1) Element or Unit of Analysis
2) Characteristic Under Study
3) Population
4) Sampling Unit
5) Sampling Frame

Technical Terms (Cont.)

6) Sample

Population — **Sample** — **Characteristic**

Farm No. 1

Farm No. 2

Farm No. 3 — Random → Farm No.3 → Rice Planted Area; Rice Harvested Area; Rice Production

⋮

Farm No. 12 — Random → Farm No. 12 → Rice Planted Area; Rice Harvested Area; Rice Production

⋮

Farm No. 100

Sampling Unit = Farm

Technical Terms (Cont.)

7) Population Value

- Parameter
- Population Mean

$$\mu = \frac{1}{N} \sum_{i=1}^{N} y_i$$

Technical Terms (Cont.)

8) Estimator

- The estimator of μ is

the sample mean : $\bar{y}$; $(\hat{\bar{Y}} \text{ or } \hat{\mu} = \bar{y})$

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{n} y_i$$

n = sample size

Technical Terms (Cont.)

9) Estimate

10) Unbiased Estimator

If $E(\bar{y})=\bar{Y}$ then $\bar{y}$ is said to be an unbiased estimator.

Technical Terms (Cont.)

11) Confidence Interval

- The frequency distribution of samples according to values of the estimator: $\hat{\theta}$ (the sample estimates)
- The sample estimation is termed the sampling distribution of the estimator: $\hat{\theta}$.
- The sampling distribution of the estimator $\hat{\theta}$ is usually close to normal, provided the sample size is sufficiently large.
- The interval $\left\{\hat{\theta} - k\sigma(\hat{\theta}),\ \hat{\theta} + k\sigma(\hat{\theta})\right\}$ is expected to include the parameter θ : in P%

Technical Terms (Cont.)

11) Confidence Interval (Cont.)

- P is the proportion of the area between –k and +k of the distribution of the standard normal distribution (mean = 0 and variance = 1)
- $\sigma(\hat{\theta})$ is the standard deviation of $\hat{\theta}$
- The interval considered is said to be a confidence interval for the parameter θ with a confidence coefficient of P with the confidence limits $\hat{\theta} - k\,\sigma(\hat{\theta})$ and $\hat{\theta} + k\,\sigma(\hat{\theta})$
- The values of the confidence coefficient P commonly used together with the corresponding values of k

Components of Survey Error

Total Error = Sampling Error + Non-Sampling Error

1. Sampling Error

- It is the error of the estimate arises only from the random sampling variation
- When n of the units are measured instead of the complete population of N units
- This error is generally measured by Sampling Variance.

Components of Survey Error (Cont.)

2. Non-sampling Error

- May occur in a complete enumeration as well as in sample survey
- Definition of the survey targets and survey items are not compatible with the survey purpose
- Imperfect Frames.
- Measurement / Observation / Response Error
- Failure to measure some of the unit and/or nonresponse
- Error induced in editing , coding and tabulating the results

Measure of Error

• The difference between the estimate $\hat{\theta}$ based on the i-th sample and the parameter namely $(\hat{\theta} - \theta)$, maybe called the error of the estimate.

• An average measure of the divergence of the difference estimates from the true value is given by the expected value of the squared error, which is know as mean square error (MSE)

$$\text{MSE}(\hat{\theta}) = E(\hat{\theta} - \theta)^2$$

•The MSE may be considered to be a measure of the accuracy.

Sampling Variance

- The expected value of the squared deviation of the estimator from its expected value (the mean obtained by repeated application of the sampling procedure) is termed sampling variance.

- It is a measure of the divergence of the estimator from its expected value.

$$V(\hat{\theta}) = \sigma^2(\theta) = E\{\hat{\theta} - E(\hat{\theta})\}^2$$

$$= E(\hat{\theta})^2 - \{E(\hat{\theta})\}^2$$

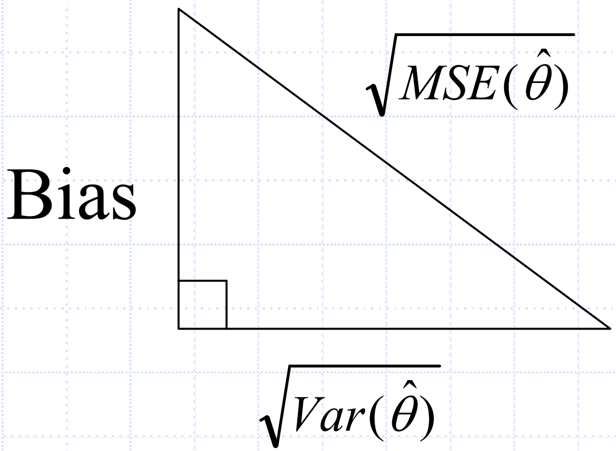
Sampling Variance (Cont.)

- This variability may be termed the precision of the estimator $\hat{\theta}$.
- The square-root of the sampling variance is termed the standard error (SE) of the estimator $\hat{\theta}$.

The relation between MSE and Sampling Variance

- Between accuracy and precision can be obtained by writing as

$$\begin{aligned}
\mathrm{MSE}(\hat{\theta}) &= \mathrm{E}(\hat{\theta}-\theta)^2 \\
&= \mathrm{E}\{\hat{\theta}-\mathrm{E}(\hat{\theta})+\mathrm{E}(\hat{\theta})-\theta\}^2 \\
&= \mathrm{E}\{\hat{\theta}-\mathrm{E}(\hat{\theta})\}^2+\{\mathrm{E}(\hat{\theta})-\theta\}^2 \\
&= \mathrm{Var}(\hat{\theta})+\mathrm{bias}^2
\end{aligned}$$



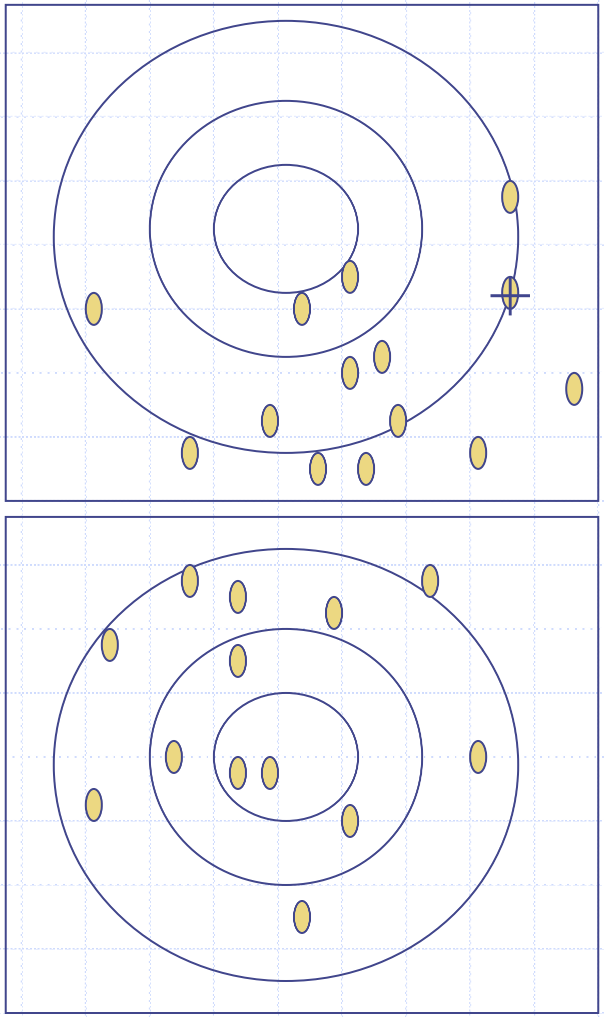
- If $\hat{\theta}$ is an unbiased estimator of θ,

$$\mathrm{MSE}(\hat{\theta}) = \mathrm{Var}(\hat{\theta})$$

Illustrates the difference between the precision and the accuracy

a)

b)

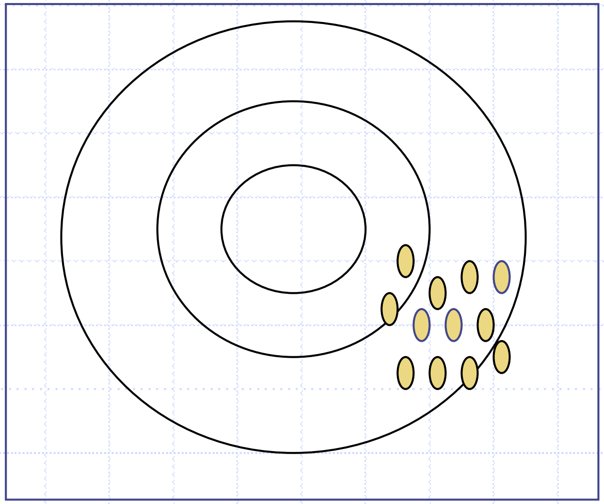


a) Low precision, high bias, low accuracy

b) Low precision, Low bias, low accuracy

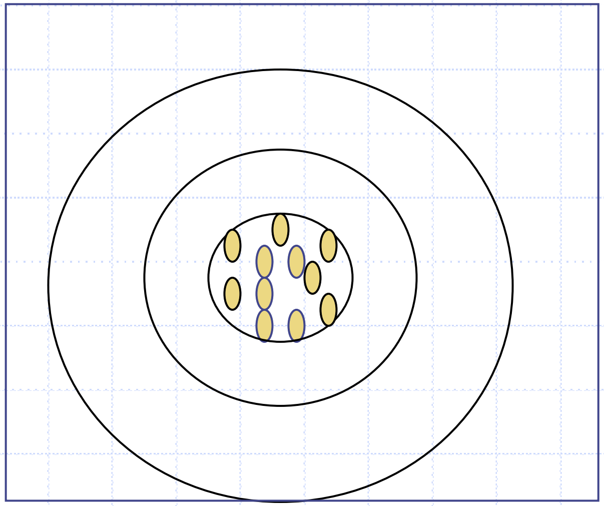
Illustrates the difference between the precision and the accuracy (cont.)

c)



c) High precision, high bias, low accuracy

d)



d) High precision, low bias, high accuracy.

Distribution of Sample Means

-Sample size = n , if the value of n is large enough , the sample means approximate a normal distribution of mean = μ and standard deviation = $\sigma/\sqrt{n}$

-The larger n becomes , the smaller the sampling error $\varepsilon = |\bar{x} - \mu|$ becomes.

Error of Purposive Selection

-Allocated sample by the purposive method , the data collected for :

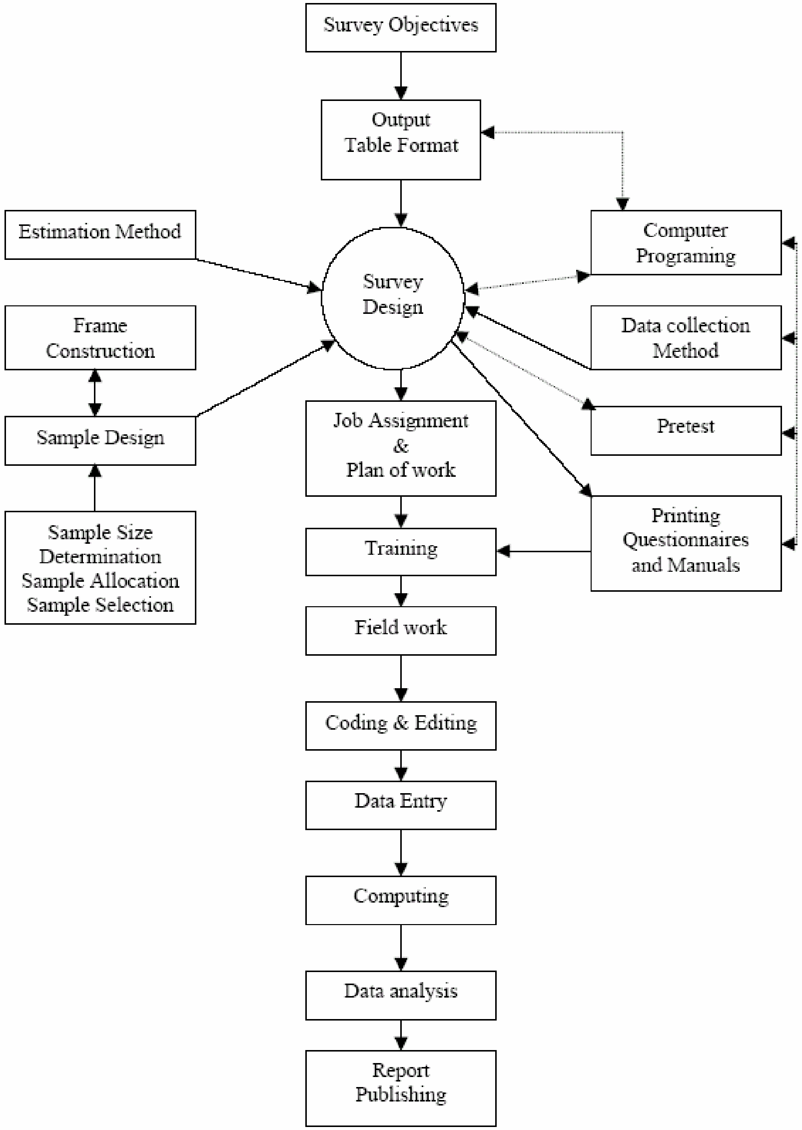
- Farm household economy survey
- Production cost survey
- Farm book-keeping collected for daily production such as para rubber's production , fresh milk from dairy cow , egg production , monthly production such as oil palm , household consumption

-Data collection is complicated
-Many people refuse to cooperate
-High fluctuation and inaccuracy

Coefficient of Variation

- The ratio of the SE of the estimator to the expected value of the estimator is known as relative standard error or coefficient of variation (CV) of the estimator.
- This is conventionally expressed as a percentage.

The Principle Steps in a Sample Survey



Sampling Procedure

For Particular survey at particular stage of sample selection, the following technique can be used.

1. Equal Probability Sampling
   1.1 Simple Random Sampling (SRS)
   1.2 Systematic Sampling (SYS)
2. Unequal Probability Sampling
   2.1 Probability Proportional to Size (PPS)

How to Draw a Simple Random Sample

- A simple random is drawn unit by unit.
- The units in the population are numbered from I to N (a population of size N)
- Every possible sample has an equal chance of selection to any number in the population.
- If a sample of size n is drawn from a population of size N in such a way that every possible sample of size n has the same chance of being selected.

How to Draw a Simple Random Sample(Cont.)

- The probability selecting one sample of size n is equal to $\frac{1}{\binom{N}{n}}$

- A series of random number between 1-N is drawn by means of a table of random number.

- In generally observed that sampling without replacement provides a more efficient estimator than sampling with replacement.

How to Draw a Systematic Sample

- The technique of systematic sampling consists in selecting every k-th unit starting with the unit corresponding to a number “r” chosen at random from 1 to k, is known as the random start and “k” is termed the sampling interval, where k is equal to N/ n , the reciprocal of sampling fraction.
- Easier to perform and provides estimators more efficient than these provided by simple random sampling under certain conditions usually met with in practice.
- This procedure amounts to selecting with equal probability one of the k possible groups of units (samples).

Unequal Probability Sampling (Vary Prob.-Sampling)

The units are selected with probability proportional to a given measure of size where the size measure is the value of a auxiliary variable : x related to the characteristic y under study and this sampling scheme is termed probability proportional to size (PPS) sampling.

General Consideration in a Survey Design

1. A clearer formulation of the objectives of the survey.
   - The formulation of data requirements should include
     - A clear statement of the desired information in statistical terms.
     - Specification of the domains of study.
     - The form in which the data should be tabulated.
     - The accuracy aimed at in the final results.
     - Cost of survey.

General Consideration in a Survey Design(Cont.)

2. Sampling Design

- Unit of analysis (e.g. , family, person, farm, area).
- Choice of sampling units [frame to be used].
- If stratification (what is the criteria to be used).
- Number of stages.
- Number of phases.
- Method of selecting sampling units in each stage
  (SRS, SYS, PPS).
- Sample size determination and sample allocation.

General Consideration in a Survey Design(Cont.)

3. Estimation method

- Sample Mean
- Ratio Estimate
- Regression Estimate

General Consideration in a Survey Design(Cont.)

4. Method of Data Collection

4.1 Personal Interview

- The most common method of measurement in household surveys.
- The success of the survey depends on the skill of the interviewer in eliciting worthwhile response.
- The information obtained from this method may be very accurate because the enumerator can clearly explain.

General Consideration in a Survey Design(Cont.)
4. Method of Data Collection (Cont.)

4.2 Telephone Interview

- It is a less expensive technique.
- The information obtained may be very limited and may be not fessible in some countries.

4.3 Mail Questionnaire

- Advantage – least expensive

  – no interviewer 's biased

  – enough time for respondents

  – there are questions which one does not like to answer in face to face conversation.

General Consideration in a Survey Design(Cont.)

4. Method of Data Collection (Cont.)

4.3 Mail Questionnaire (Cont.)

- Disadvantage

– Simple and straight forward questions are required.

– In opinion survey when individual opinion is wanted, the mail survey may give us a consensus of opinion because of the discussion among the family members.

– Very low rate of response

– Very often cannot assume that the return questionnaire.

4. Method of Data Collection (Cont.)

4.4 Direct Observation

– By physical observation or measurement or using a measuring instrument.

– This method should be the best method of collecting information as it is free from memory errors of respondents, exaggeration, and prestige effects.

– It may involve greater effort and cost.

General Consideration in a Survey Design(Cont.)

4. Method of Data Collection (Cont.)

4.5 Transcription from Records

– When the data needed for a specific purpose are already available in registers maintained in one or more places.

– This method is extensively used, since a good deal of government and business statistics are collected as by-product of routine administrative operations.

4.6 Book Keeping

– When the survey date is very far from the reference date, the interview technique may be not appropriate because the respondent cannot remember the answer.

– The cost may be more expensive as compared with one time interview.

General Consideration in a Survey Design (Cont.)

5. Questionnaire Design

5.1 Question Content

- Cover all required information
- Internal check

5.2 Design of Forms

- Manual / Computer processing
- Simple and clear
- Attractive looking
- Enough space for recording
- Facilitating field handling
- Facilitating the job of editor and entry operators

General Consideration in a Survey Design (Cont.)

5. Questionnaire Design (Cont.)

5.3 Question Order

- Arranged logically
- Simple question before difficult question
- Specific question follow general one

5.4 Question Wording

- Must be aware of the concepts and definitions
- Leading question should be avoided
- Question of hypothetical nature should be avoided

5.5 Question Types

- Closed question or Fixed response question
- Open - ended question

General Consideration in a Survey Design (Cont.)

6. Field Work

- Pretest (The questionnaire and the field work procedure)
- Preparation of questionnaire and survey manual
- Training of enumerators
- Supervision of enumerators

7. Data Processing

- Coding / Editing / Tabulating
- Computing

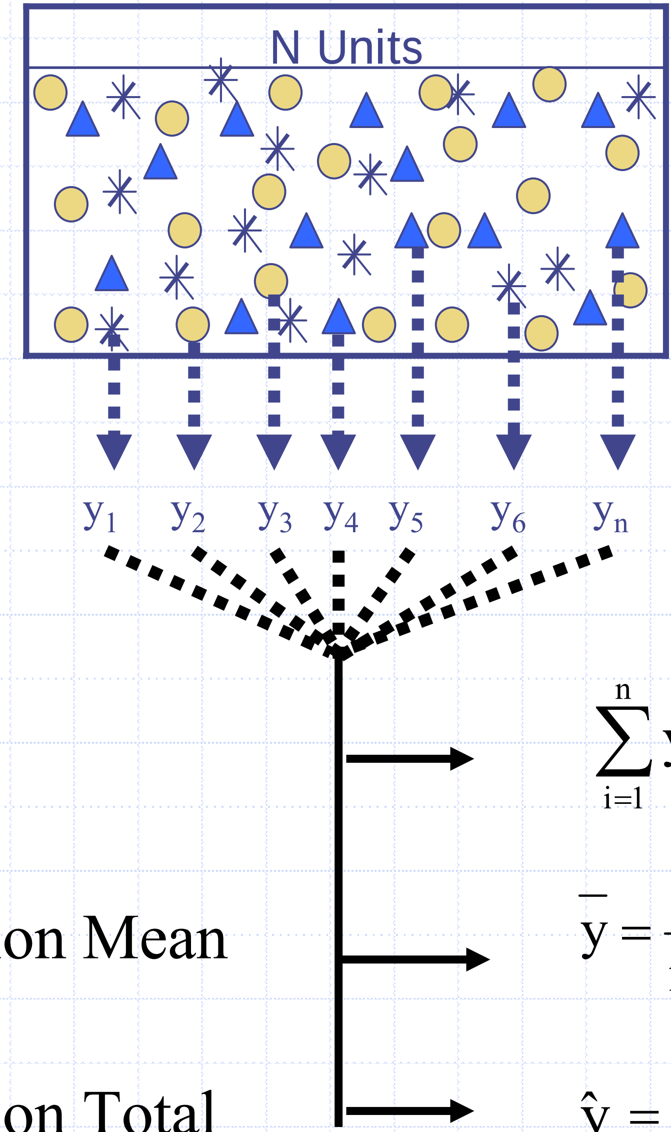
General Consideration in a Survey Design (Cont.)

8. Review and Analysis of Survey Results
   - Internal Consistency
   - External Consistency

9 Report Writing

- Statement of purpose of the survey
- Description of the coverage
- Design of the survey
- Reference period and the survey period
- Responsible agency

Simple Random Sampling



- Randomly selected n units out of N units
- Measure the value of characteristic under study of each selected unit

Sample Total $\sum_{i=1}^{n} y_i$

Estimate Population Mean $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$

Estimate Population Total $\hat{y} = N\bar{y} = \frac{N}{n}\sum_{i=1}^{n} y_i$

Simple Random Sampling (Cont.)

1. Definition

- If a sample of size n is drawn from a population of size N in such a way that every possible sample of size n has the same chance of being selected, the sampling procedure is called simple random sampling.

- The probability of selecting one sample of size n is equal to

$$\frac{1}{{}_N C_n}$$

Simple Random Sampling (cont.)

2. How to draw sample

- Sample is drawn unit by unit, the units in the population are numbered from 1 to N, a series of random numbers between 1 and N.
- A series of random numbers is drawn by means of a table of random numbers, selection to any number in the population not already drawn.

Simple Random Sampling (cont.)

3. Estimation of a Population Mean ($\overline{Y}$ or μ)

- The estimator of $\overline{Y}$ is $\overline{y}$

$$\overline{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

$$\hat{V}(\overline{y}) = \frac{(N-n)}{N}\frac{s^2}{n}$$

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \overline{y})^2$$

Simple Random Sampling (cont.)

4. Estimation of a population Total (Y)

- The estimator of Y is $\hat{Y}$

$$\hat{Y} = N\bar{y} = \frac{N}{n}\sum_{i=1}^{n} y_i$$

- $f = \frac{n}{N}$ is call sampling fraction
- $1-f$ is called finite population correction (fpc)

$$\hat{V}(\hat{Y}) = N^2\hat{V}(\bar{y}) = N(N-n)\frac{s^2}{n}$$

Simple Random Sampling (cont.)

5. Coefficient of Variation (CV)

- Coefficient of $\bar{y}$ and $\hat{Y}$ can be estimated by

$$CV(\bar{y}) = \frac{SE(\bar{y})}{\bar{y}} \times 100$$

$$\text{and} \quad CV(\hat{Y}) = \frac{SE(\hat{Y})}{\hat{Y}} \times 100$$

Simple Random Sampling (cont.)

6. Interval Estimate

- The interval

  - $\bar{y} \pm Z_{\alpha/2} \text{ SE } (\bar{y})$
  - $\hat{Y} \pm Z_{\alpha/2} \text{ SE } (\hat{Y})$

- The number $\bar{y} - Z_{\alpha/2} \text{ SE } (\bar{y})$ and $\bar{y} + Z_{\alpha/2} \text{ SE } (\bar{y})$

  are called confidence limits , lower and upper limits

  and the probability with which the inequality hold

  (e.g 0.95 or 1-α) is called confidence coefficient and

  (1-α)100 or95% is called confidence level.

Simple Random Sampling (cont.)

7. Estimation of a Population Proportion (Qualitative Characteristic)

- Sometimes we wish to estimate the total number , the proportion , or the percentage of units in the population that posses some characteristic or attribute or fall into some defined class.

Simple Random Sampling (cont.)

8. Simpling size Determination

- In planning a survey , a stage is always reached at which a decision must be made about , the size of the sample
- The decision is important , too large a sample implies a waste of resources , and too small a sample diminishes the utility of the results.
- The number of observations needed to estimate a population parameter with a given precision (Bound on the error of estimation , B)

Simple Random Sampling (cont.)

8. Sampling size Determination (Cont.)

$$n = \frac{Nk^2s^2}{NB^2 + k^2s^2}$$

N = A population size

B = k (SE) , B is given

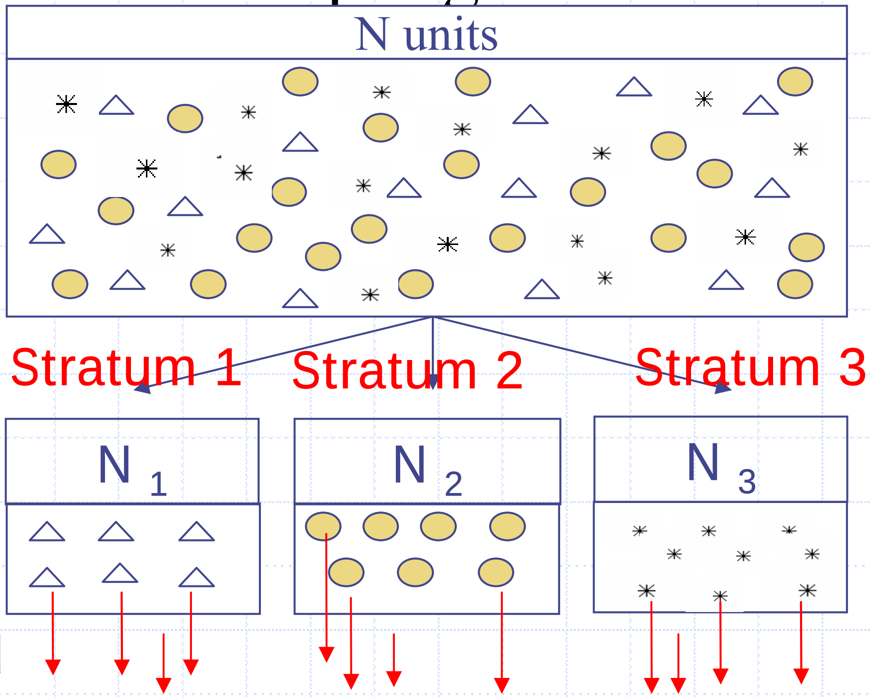
k = 1.96 for 95% confidence interval

= 2.54 for 99% confidence interval

= 1.65 for 90 % confidence interval

SE = standard error formula

Stratified Random Sampling



Stratified :

- homogeneity within stratum
- Heterogeneity between strata

Randomly selected n_h out of N_h

$$\sum_{i=1}^{n_1} y_{1i} \qquad \sum_{i=1}^{n_2} y_{2i} \qquad \sum_{i=1}^{n_3} y_{3i}$$

Sample total

$$\hat{Y}_1 = \frac{N_1}{n_1}\sum_{i=1}^{n_1} y_{1i} = N_1 \bar{y}_1 \qquad \hat{Y}_2 = \frac{N_2}{n_2}\sum_{i=1}^{n_2} y_{2i} = N_2 \bar{y}_2 \qquad \hat{Y}_3 = \frac{N_3}{n_3}\sum_{i=1}^{n_3} y_{3i} = N_3 \bar{y}_3$$

Estimate Strata Total

Stratified Random Sampling (Cont.)

- Estimate Population Total

$$\hat{Y} = \hat{Y}_1 + \hat{Y}_2 + \hat{Y}_3 = \sum_{h=1}^{3} \hat{Y}_h$$

- Estimate Population Mean

$$\overline{y}_{st} = \frac{\hat{Y}}{N} = \frac{1}{N} \sum_{h=1}^{3} N_h \overline{y}_h$$

$$= \sum_{h=1}^{3} W_h \overline{y}_h \;, W_h = \frac{N_h}{N}$$

Stratified Random Sampling (Cont.)

1. Definition

-A stratified Random Sampling , sample is one obtained by separating the population elements into non over lapping groups , called strata , and then selecting a simple random sample from each stratum.

2. Reasons

- The data should be more homogeneous within each stratum then in the population as a whole.

Stratified Random Sampling (Cont.)

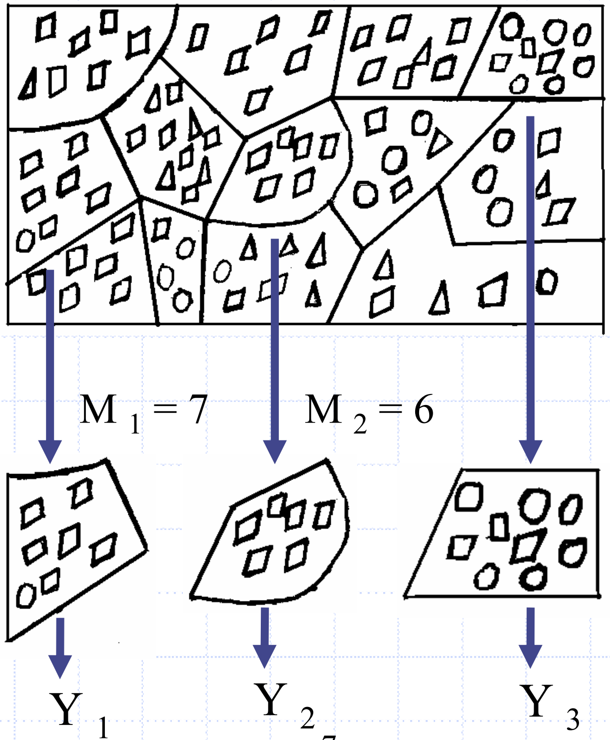
2. Reasons (Cont.)

- The cost of conducting the actual sampling tends to be less for stratified random sampling than for simple random sampling because of administrative convenience.
- When stratified sampling is used , separate estimates of population parameters can be obtained for each stratum.

3. How to draw a stratified random sample

- Clearly specify the strata
- Place each sampling unit of the population into its appropriate stratum.
- Select a simple random sample from each stratum

Cluster Random Sampling



$N = 13$

$M = \sum_{i=1}^{13} M_i$

:

- homogeneity between clusters
- heterogeneity within cluster

Randomly selected 3 cluster(n) out of 13 cluster (N)

$M_3 = 9$

Measure every unit in selected cluster

$$Y_1 = \sum_{j=1}^{7} y_{1j}$$

$$Y_2 = \sum_{j=1}^{6} y_{2j}$$

$$Y_3 = \sum_{j=1}^{9} y_{3j}$$

Sample Cluster Total

-Estimate Population Mean (per unit) $\bar{y}_r = \dfrac{\sum_{i=1}^{3} Y_i}{\sum_{i=1}^{3} M_i}$

Cluster Random Sampling(Con.t)

- Estimate Population Total $\hat{Y}$

$$\hat{Y} = M\,\bar{y}_r$$

When M is known

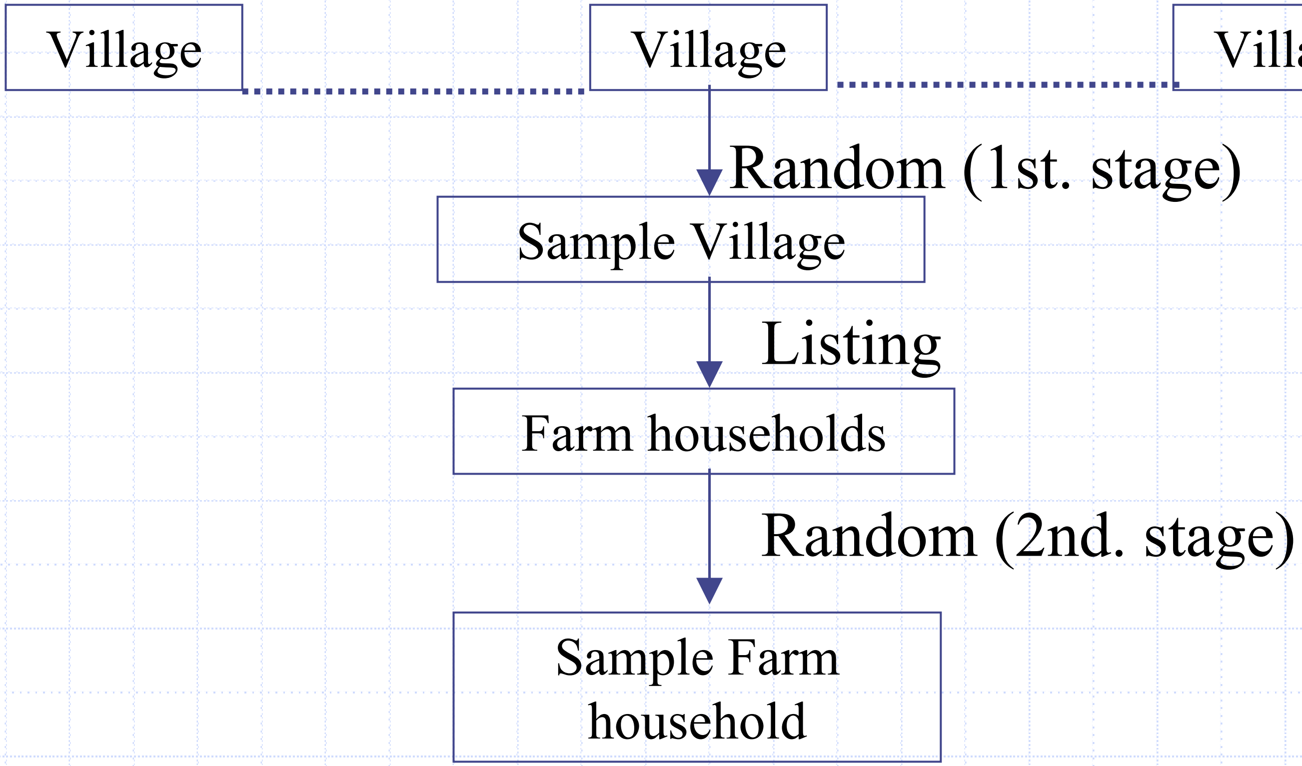
- Cluster Average $\bar{y}_c = \frac{1}{n}\sum_{i=1}^{n} Y_i$

$$\hat{Y} = N\,\bar{y}_c$$

$$\hat{Y} = \frac{N}{n}\sum_{i=1}^{n} Y_i$$

When M is unknown

Two – stage Random Sampling



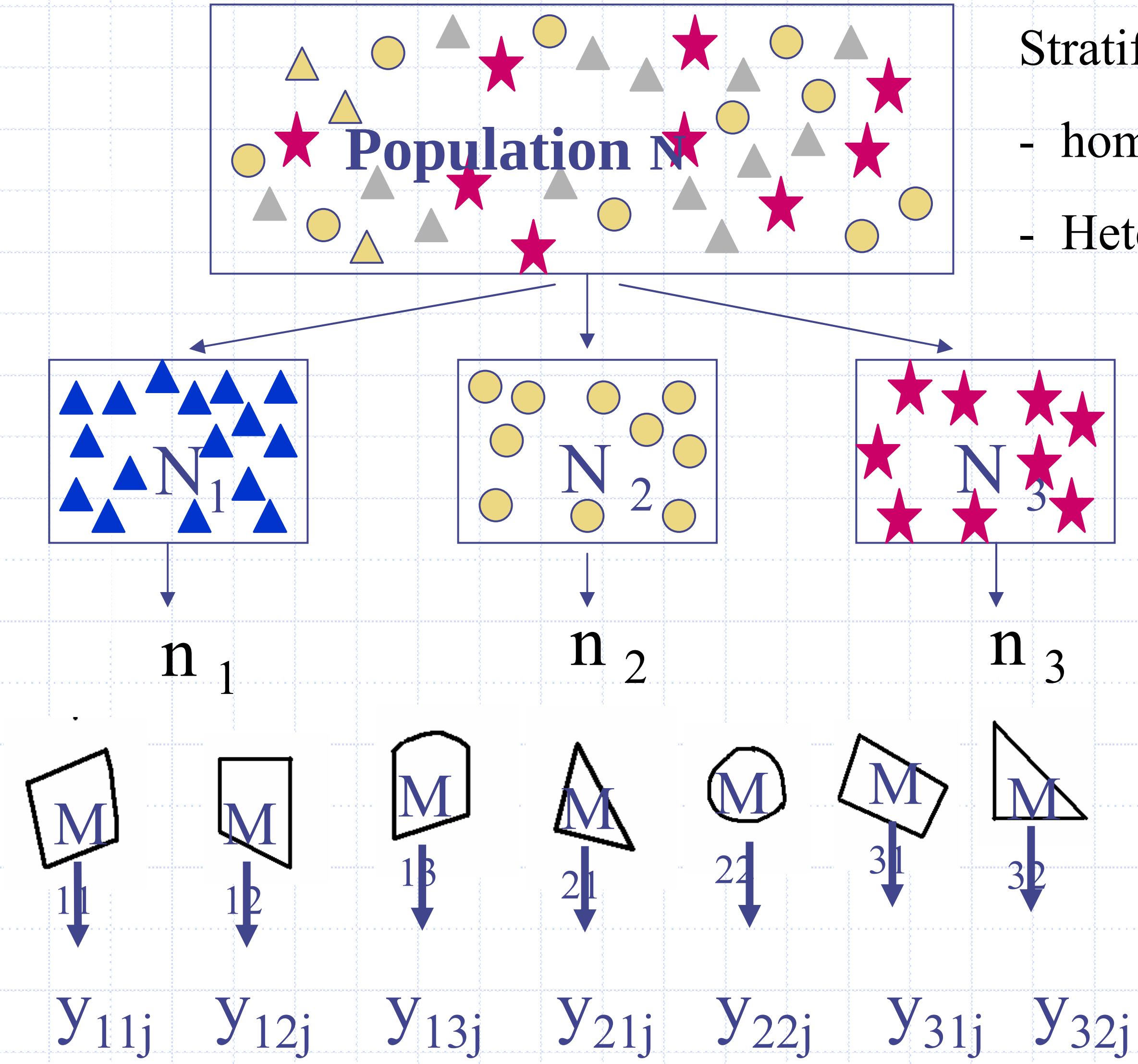
-Villages are the primary sampling units.

- Farm households are the secondary sampling units.

- Sampling frame for the first stage selection is the list of villages.

- Sampling Frame for the second stage selection is the list of households (names).

Stratified Two-stage Random Sampling



Stratified :

- homogeneity within stratum
- Heterogeneity between strata

Randomly selected PSU from each and every stratum

Randomly selected sample units from each and every selected PSU

$j = 1,2,3,\ldots\ldots, m_{hi}$

Stratified Two-stage Random Sampling(Cont.)

$$\hat{Y}_1 = \frac{N_1}{n_1}\sum_{i=1}^{n_1}\frac{M_{1i}}{m_{1i}}\sum_{j=1}^{m_{1i}} y_{1ij}$$

$$\hat{Y}_2 = \frac{N_2}{n_2}\sum_{i=2}^{n_2}\frac{M_{2i}}{m_{2i}}\sum_{j=1}^{m_{2i}} y_{2ij}$$

$$\hat{Y}_3 = \frac{N_3}{n_3}\sum_{i=3}^{n_3}\frac{M_{3i}}{m_{3i}}\sum_{j=1}^{m_{3i}} y_{3ij}$$

Stratified Two-stage Random Sampling (Cont.)

- Estimate Population Total $\hat{Y} = \hat{Y}_1 + \hat{Y}_2 + \hat{Y}_3$

$$\hat{Y} = \sum_{h=1}^{3} \frac{N_h}{n_h} \sum_{i=1}^{n_h} \frac{M_{hi}}{m_{hi}} \sum_{j=1}^{m_{hi}} y_{hij}$$

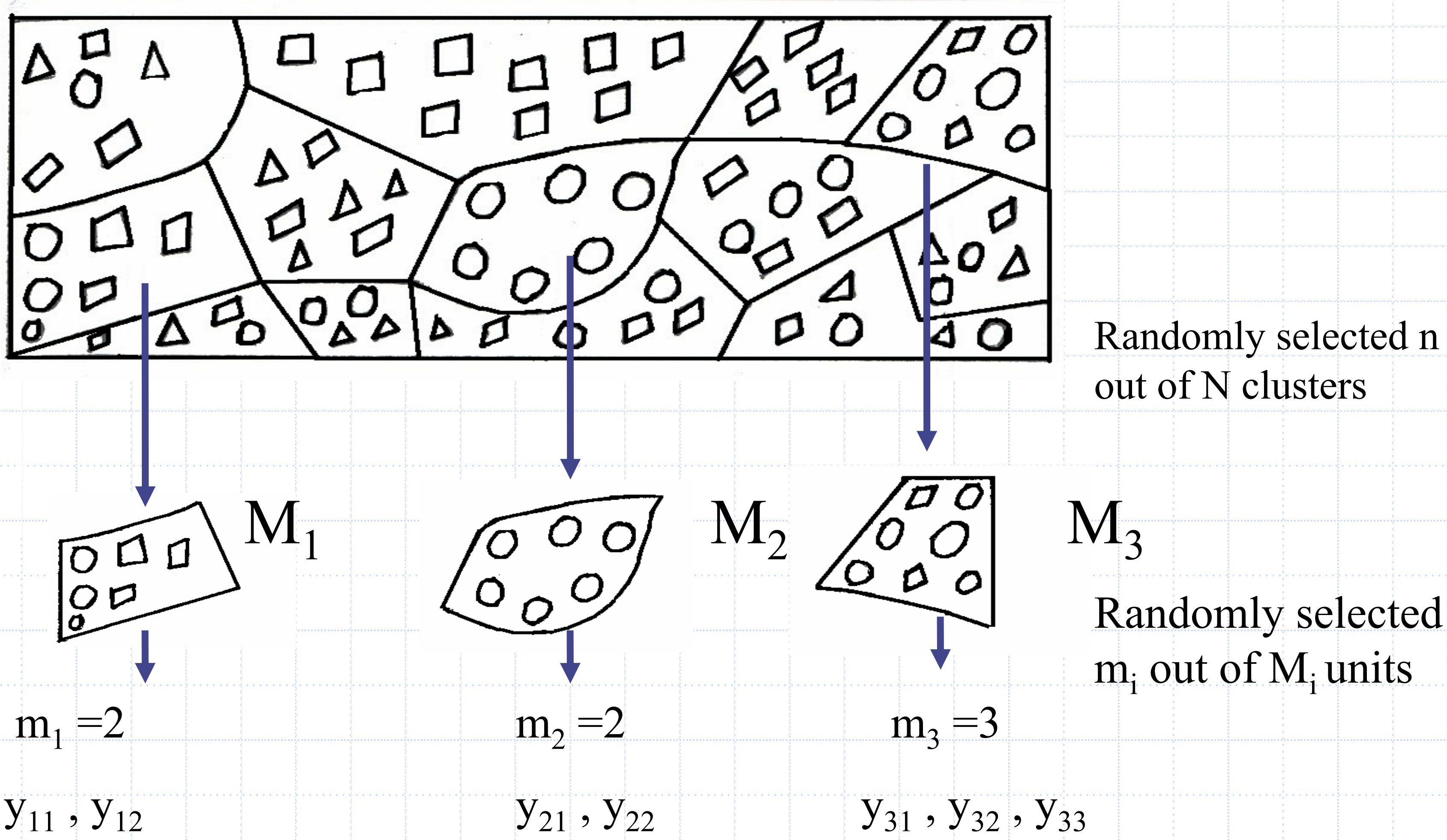
- Estimate Population Mean

$$\bar{y} = \frac{\hat{Y}}{\hat{M}}$$

$$\hat{M} = \sum_{h=1}^{3} \hat{M}_h$$

$$= \sum_{h=1}^{3} \frac{N_h}{n_h} \sum_{i=1}^{n_h} M_{hi}$$

Two-stage Cluster Random Sampling



Two-stage Cluster Random Sampling (Cont.)

- Estimate Cluster Total

$$\hat{Y}_1 = \frac{M_1}{m_1} \sum_{j=1}^{m_1} y_{1j}$$

$$\hat{Y}_2 = \frac{M_2}{m_2} \sum_{j=1}^{m_2} y_{2j}$$

$$\hat{Y}_3 = \frac{M_3}{m_3} \sum_{j=1}^{m_3} y_{3j}$$

Two-stage Cluster Random Sampling (Cont.)

- Estimate Population Total

$$\hat{Y} = \frac{N}{n}(\hat{Y}_1 + \hat{Y}_2 + \hat{Y}_3)$$

$$= \frac{N}{n}\sum_{i=1}^{n} \hat{Y}_i$$

$$= \frac{N}{n}\sum_{i=1}^{n} \frac{M_i}{m_i}\sum_{j=1}^{m_i} y_{ij}$$

- Estimate Population Mean

$$\overline{y}_r = \frac{\hat{Y}}{\hat{M}}$$

$$\hat{M} = \frac{N}{n}\sum_{i=1}^{n} M_i$$

Survey Technique

The sampling survey technique use such as

1. List Frame Survey

2. Area Frame Survey

3. Observation Yield Survey or *Crop cutting*

4. Rural Rapid Appraisal : *RRA*

Interview survey based on list frame

List frame

Frame or population defined as a list of sampling units ; provinces, districts villages households etc.

Interview survey

The classic sample survey operation that enumerates by mainly sampling units interviewing

Methodology

based on

- *Probability Theory*
- *Sampling Theory*
- *Estimation Theory*
- *Etc.*

Sampling Design (on major rice)

→ ***-Stratified two stage systematic sampling***

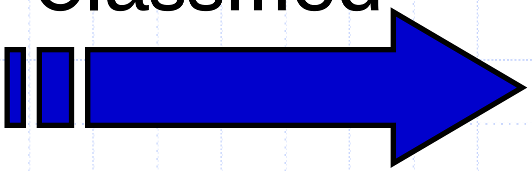
Estimation (scheme)

→ ***- Mean per unit estimation***

- Ratio estimation

Stratification
(for heterogeneous)

Classified



Into “strata”

- Irrigation/non-irrigation

- Sizes of sampling units (sub-villages)

- Number of sampling units

- Specific area ; Sensitive/non-sensitive rice planted area

Two-stage in population (sampling unit)

provinces

1^{st} - ***stage sampling unit (psu)***
= sub village (mooban)

2^{nd} - ***stage sampling unit (ssu)***
= farm household

Systematic
(psu only)

- sorting planted area of psu in sub-villages in each stratum

- Taking psu sample by systematic sampling in each stratum

Field survey operation

- Enumerate data from household sample (using simple random sampling at least 10 fhs.) by ROAE officer

Data Processing
(on line)

- Data entry

- Verification

- Program execution

Preliminary data
(output statistics)

- Rearrange output statistics in the form of report

CAI - committee

- Discuss & analyze by using output data /crop cutting data /data from AFS. and others

Public Dissemination

- Website
- Annual Statistics Year book

Thank you