

Chapter 2 – Designing Observational Studies and Experiments
Section 2 – Systematic, Stratified, Cluster Sampling

Materials Needed: TI Calculators, StatCrunch

Objectives

1. Identify and explain systematic sampling.
2. Identify and explain stratified sampling.
3. Identify and explain cluster sampling.
4. Compare sampling methods.
5. Describe why convenience sampling and voluntary response sampling should never be used.

Vocabulary

1. systematic sampling
2. stratified sampling
3. cluster sampling
4. convenience sampling
5. voluntary response sampling

Lesson/Activity

OBJECTIVE 1 – Identify and explain systematic sampling.

Definition: Systematic sampling

To perform **systematic sampling**, we randomly select an individual out of the first k individuals and select every k th individual after the first selected individual.

Warning: Once k is chosen, the researcher must make sure that selecting every k th individual does not match with some pattern in the population.

1. A Target manager wants to survey customers as they leave the store on a certain day. There are about 925 customers each day. The manager would like to get feedback from at least 75 customers. From past experience, the manager knows that if 100 customers are approached, about 75 of them will participate in the survey.
 - a. Given that the manager wants to survey customers as they leave the store, explain why it would not be possible to perform simple random sampling.
 - b. The manager decides to perform systematic sampling. If every k th customer is approached, find k so that 100 customers are approached.
 - c. To find which customer should be first approached, use 822 as the seed to find a random number between 1 and k , inclusive.
 - d. List the first 5 customers who should be approached.

We should always round down when calculating k for systematic sampling.

A key benefit of systematic sampling is that a frame is not required.

OBJECTIVE 2 – Identify and explain stratified sampling.

Definition: Stratified sampling

To perform **stratified sampling**, a population is divided into subgroups called **strata** (singular: **stratum**) and simple random sampling is performed on each stratum. In each stratum, the individuals share some characteristic. The ratios of the number of individuals selected from each stratum are equal to the corresponding ratios of the stratum sizes.

Benefits of stratified sampling:

- Individuals in small strata are not excluded.
- A smaller sample can be selected than by using simple random sampling.
- This saves time, money, and effort.

2. Emory University wants to survey a sample of 250 students from the class of 2015, asking them whether they feel like they belong. The numbers of students are shown in the following table for various ethnicities. How many students of each ethnicity should be included in the study?

<u>Ethnicity</u>	<u>Number of Students</u>
Caucasian	1826
Asian American	800
African American	425
Latino	507
Multi-Racial	155
Native American	1
International	855
<u>Did Not Identify</u>	<u>261</u>

Source: Emory University

3. Western Illinois University, Quad Cities, wants to survey its students about their first-semester experience. Because female undergraduates, male undergraduates, female transfer students, male transfer students, female graduate students, and male graduate students may have had different experiences, the university plans to use these six types of students as strata. The strata sizes are shown in the following table. If the university wants to survey 150 students, how many students in each stratum should be surveyed?

<u>Gender</u>	<u>Freshmen</u>	<u>Undergraduate Transfer</u>	<u>First-Time Graduate</u>	<u>TOTAL</u>
Female	154	234	115	503
Male	130	186	52	368
Total	284	420	167	871

Source: Western Illinois University

OBJECTIVE 3 – Identify and explain cluster sampling.

Definition: Cluster sampling

To perform **cluster sampling**, a population is divided into subgroups called **clusters**.

Then simple random sampling is used to select some of the clusters. All the individuals in those selected clusters form the sample.

Benefits of cluster sampling:

- It does not require constructing a frame of individuals.
- It saves time, money, and effort.

Explain Example 3 (page 104) in textbook.

- Boston Mayor Marty Walsh wants data collectors to conduct in-person interviews with some Boston residents. If each city block is treated as a cluster, describe how cluster sampling could be accomplished.

OBJECTIVE 4 – Compare sampling methods.

Sampling Method	Requirement	Benefits
Simple Random	A frame of all individuals.	Works fine for telephone and e-mail surveys in which there is little risk of excluding anyone.
Systematic	Selecting every kth individual must not match with some pattern in the population.	No frame is required.
Stratified	In each strain, individuals are similar. A frame for individuals in each stratum.	Individuals in small strata are not excluded from the sample. Can save time, money, and effort.
Cluster	A frame of clusters.	No frame of individuals is required. Can save time, money, and effort.

OBJECTIVE 5 – Describe why convenience sampling and voluntary response sampling should never be used.

Definition: Convenience sampling

To perform **convenience sampling**, we gather data that are easy to collect and do not bother with collecting them randomly.

Although convenience sampling is easy to perform, it should never be done because the sample will usually not represent the population well.

Definition: Voluntary response sampling

To perform **voluntary response sampling**, we let individuals choose to be in the sample.

Never perform voluntary response sampling or the more general convenience sampling.

Identify whether the sampling method is simple random, systematic, stratified, cluster, or convenience. Explain.

- In a study at a university, 250 students are selected from each of the classes freshmen, sophomores, juniors, and seniors.
- Home Depot creates a frame of all its 340 thousand employees and randomly selects some of the employees.
- A blog hosts an online survey, asking respondents whether they go to the movies at least once per month.
- Twenty Burger King locations in the United States are randomly selected and all the employees at those locations are surveyed.
- A police unit stops every fourth car on a highway and tests whether the driver is driving under the influence of alcohol.

Homework/Assessment

1, 3, 5, 7, 9, 11, 13, 19, 27, 29, 31, 33, 39, 43, 45