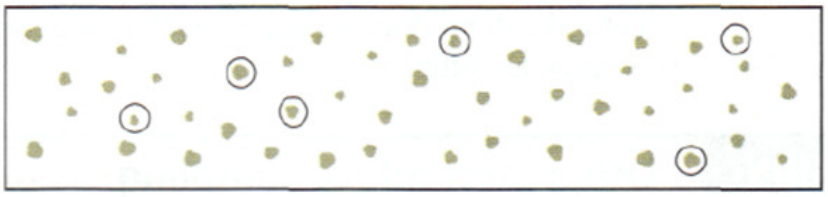
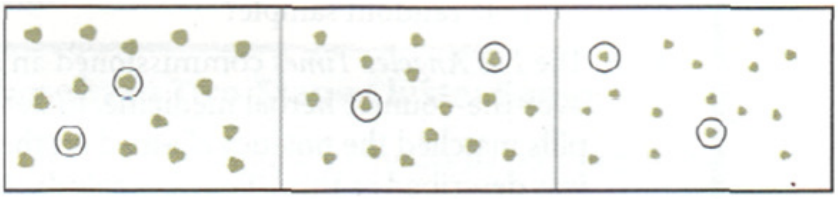
Section 4.2 Notes
Random Sampling

Simple Random Sample: all possible samples of a given fixed size are equally likely

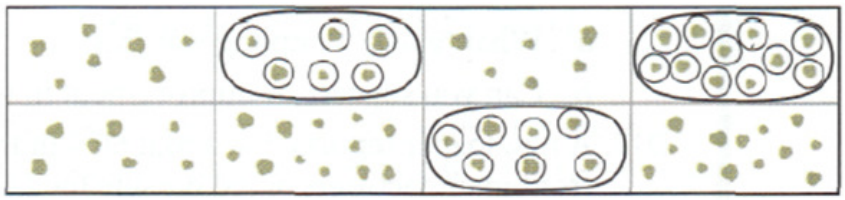
*All units have the same chance of belonging to the sample.



Stratified Random Sample: dividing a population into mutually exclusive groups and taking a simple random sample from each

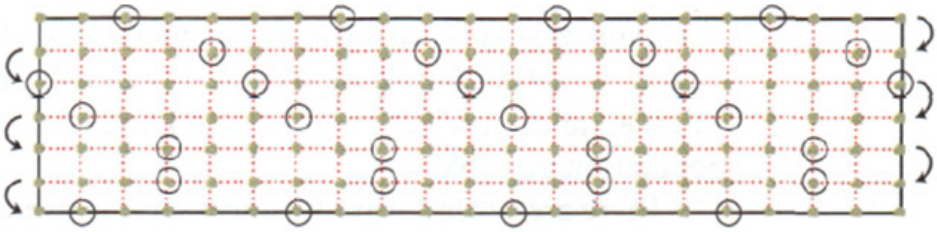


Cluster Sampling: sampling in which the entire population is divided into subgroups. A simple random sample of the subgroups is done and each individual in the chosen subgroup is surveyed



Two-Stage Cluster Sampling: a type of cluster sampling in which in each subgroup chosen, a simple random sample of the subgroup is surveyed

Systematic Sampling: a sampling method in which every k^{th} number is selected starting at a random number



Section 4.3 Notes
Experiments and Inferences about Cause

Treatments: conditions assigned to different groups of subjects to determine whether subjects respond differently to different conditions.

Response: the outcome variable used to compare results of different treatments in an experiment.

Two possible influences on an observed outcome are confounded if they are mixed together in a way that makes it impossible to separate their effects on the responses.

In an observational study, no treatments get assigned to the units by the experimenter – the conditions of interest are already built into the units being studied.

For drawing conclusions about cause and effect, a good randomized experiment is nearly always better than a good observational study.

Factors: an explanatory variable, usually categorical, in a randomized experiment or observational study.

Levels: one of the values or categories making up a factor.

Why Randomization Makes Inference Possible:

- If you assign treatments to units at random, then there are only two possible causes for a difference in the responses to the treatments: chance or the treatments.
- If the probability is small that chance alone will give you such a difference in the responses, then you can infer that the cause of the difference was the treatment.

Control/Comparison Group

Placebo: a fake treatment

Placebo Effect: when people do better because they think they are receiving good care.

Control Group: subjects that receive a placebo

Treatment Group: subjects that are given the drug to be evaluated.

The control and treatment groups are to be handled exactly alike except for the treatment itself.

Blinding:

Blinding: when a patient doesn't know whether they are in the control or treatment group.

Double Blinding: when a patient and researcher (dOctor) doesn't know whether they are in control or treatment group.

Randomized Comparative Experiment

A good experiment must have both a random assignment of treatments to units and a control group that is compared to the group getting the treatment of interest.

Experimental Units: the people, animals, families, classrooms, and so on to which treatments are randomly assigned.

Replication: the random assignment of the same treatment to different units.

Characteristics of a Well-Designed Experiment:

- Compare: A treatment group is compared to a control group, or two or more treatment groups are compared to each other.
- Randomize: Treatments are randomly assigned to the available experimental units.
- Replicate: Each treatment is randomized to enough experimental units to provide adequate assessment of how much the responses from the same treatments vary.

Section 4.4 Notes
Designing Experiments to Reduce Variability

In order to conclude that the treatments make a difference, the difference between the treatments has to be large enough to overshadow the variation within each treatment.

Steps in Creating a Completely Randomized Design:

1. Number the available experimental units from 1 to n.
2. If you have three treatments, for example, use a random number generator to pick n/3 integers at random, discarding any repetition. The units with those numbers will be given the first treatment. Repeat for the second treatment. The remaining units will get the third treatment.

Steps in Creating a Randomized Pair Comparison Design

1. Sort your available experimental units into pairs of similar units. The two units in each pair should be enough alike that you expect them to have a similar response to any treatment.
2. Randomly decide which unit in each pair is assigned which treatment.

Steps in Creating a Randomized Block Design

1. Sort your available units into groups (blocks) of similar units. The units in each block should be enough alike that you expect them to have a similar response to any treatment (called blocking).
2. Randomly assign a treatment to each unit in the first block. Then go to the second block and randomly assign a treatment to each unit in the block. Repeat for each block.