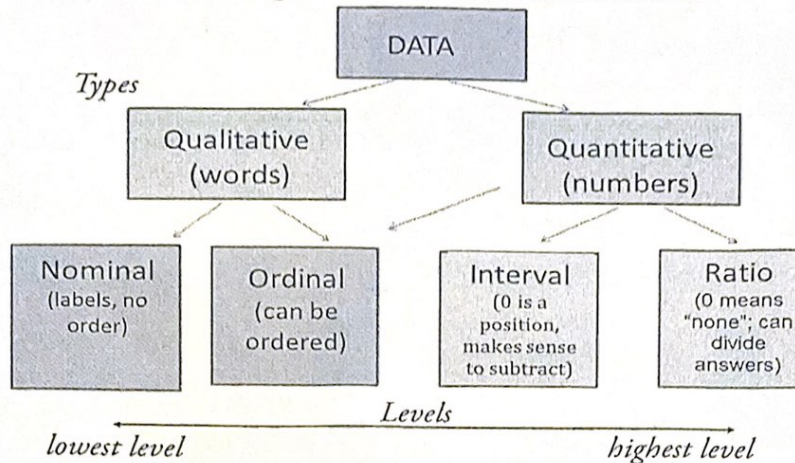


## Visual Organization of Data Classification



### 3.3 Notes

#### Objectives:

- ☐ Can you summarize how to design a statistical study?
- ☐ Can you identify data collection techniques?
- ☐ Can you design an experiment?

#### Designing a Statistical Study

1. Identify the variable(s) of interest (the focus) and the population of the study.
2. Develop a detailed plan for collecting data. If you use a sample, make sure the sample is representative of the population.
3. Collect the data.
4. Describe the data using descriptive statistics techniques.
5. Interpret the data and make conclusions about the population using inferential statistics.
6. Identify any possible errors.

#### → Observational study

- ☐ A researcher observes and measures characteristics of interest of part of a population.

Sample: Researchers observed and recorded the mouthing behavior on nonfood objects of children up to three years old. (Source: Pediatric Magazine)

#### → Experiment

- ☐ A treatment is applied to part of a population and responses are observed.
- ☐ Subjects are called experimental units
- ☐ Another part of the population receives no treatment: control group

Sample: An experiment was performed in which diabetics took cinnamon extract daily while a control group took none. After 40 days, the diabetics who had the cinnamon reduced their risk of heart disease while the control group experienced no change. (Source: Diabetes Care)

## → Simulation

- ☐ Uses a mathematical or physical model to reproduce the conditions of a situation or process.
- ☐ Often involves the use of computers.

Sample: Automobile manufacturers use simulations with dummies to study the effects of crashes on humans.

often used for: sit. impractical or dangerous to create

## → Survey

- ☐ An investigation of one or more characteristics of a population. → usually carried out on people
- ☐ Commonly done by interview, mail, or phone/text/email.
- ☐ A census attempts to question the whole population.

Sample: A survey is conducted on a sample of female physicians to determine whether the primary reason for their career choice is financial stability.

Examples: Consider the following statistical studies. Which method of data collection would you use to collect data for each study?

1. A study of the effect of changing flight patterns on the number of airplane accidents.

simulation

2. A study of the effect of eating oatmeal on lowering blood pressure.

experiment

3. A study of how fourth grade students solve a puzzle.

observational study

4. A study of U.S. residents' approval rating of the U.S. president.

survey

## KEY ELEMENTS OF EXPERIMENTAL DESIGN

- ☐ Control
- ☐ Randomization
- ☐ Replication

✓ **Control** for effects other than the one being tested.

☐ **Confounding variables**

- ☐ Occurs when an experimenter cannot tell the difference between the effects of different factors on a variable.

Sample: A coffee shop owner remodels her shop at the same time a nearby mall has its grand opening. If business at the coffee shop increases, it cannot be determined whether it is because of the remodeling or the new mall.

- ☐ **Placebo**: A false treatment. Subjects (experimental units) may believe they are receiving a treatment, but it is not a true one.

☐ **Placebo effect**

- ☐ A subject reacts favorably to a placebo when in fact he or she has been given no medical treatment at all.

Ease migraines

Sample: Andrew suffers from chronic neck pain. His doctor gives him a sugar pill (a placebo), and Andrew reports less neck pain.

☐ **The Placebo effect needs to be controlled in an experiment!**

- ☐ **Blinding** is a technique where the subject does not know whether he or she is receiving a treatment or a placebo.
- ☐ **Double-blind** experiment neither the subject nor the experimenter knows if the subject is receiving a treatment or a placebo.

✓ **Randomization** is a process of randomly assigning subjects to different treatment groups.

★ ☐ **Completely randomized design**

- ☐ Subjects are assigned to different treatment groups through random selection.

★ ☐ **Randomized block design**

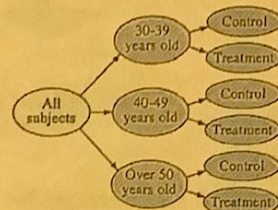
- ☐ Divide subjects with similar characteristics into **blocks**, and then within each block, randomly assign subjects to treatment groups.

### Randomized design

Sample: A doctor wants to try a new treatment on patients with Alzheimer's disease. He puts the names of 100 patients in a hat, and randomly draws the names of 20 patients to try the new treatment.

### Randomized block design

Sample: An experimenter testing the effects of a new weight loss drink may first divide the subjects into age categories. Then within each age group, randomly assign subjects to either the treatment group or control group.



### ★ ☐ Matched Pairs Design

- ☐ Subjects are paired up according to a similarity. One subject in the pair is randomly selected to receive one treatment while the other subject receives a different treatment.

Sample: The athletic trainer at a university wants to test the effectiveness of a new protein shake. He has 20 athletes, and he puts them in pairs based on their starting similar physical condition. One member from each pair will receive the treatment, while the other member receives a placebo.

✓ Replication is the repetition of an experiment using a large group of subjects.

Sample: To test a vaccine against a strain of influenza, 10,000 people are given the vaccine and another 10,000 people are given a placebo. Because of the sample size, the effectiveness of the vaccine would most likely be observed. (Both groups must be similar... age, gender, etc.)

Example: A company wants to test the effectiveness of a new gum developed to help people quit smoking. Identify a potential problem with the given experimental design and suggest a way to improve it.

The company identifies one thousand adults who are heavy smokers. The subjects are divided into blocks according to gender, and each block is given the new gum. After two months, the female group has a significant number of subjects who have quit smoking. Groups not similar, no control groups

could do: male < control  
                  < treat  
                  female < control  
                          < treat

Ex. 2 groups: 5 subj new gum  
(all heavy smokers) 5 subj. placebo

After 2 mo - 5 subj given gum have quit smoking

Prob really small sample size → replicate exper. to impr. validity

