

Intro:

Suppose we find that a good deal of weight loss occurs in people who are using a particular diet drug.

Can we conclude that the drug caused the weight loss?

We conduct **experiments** to determine if a cause-and-effect relationship exists between variables.

Vocabulary of Experiments

Experimental units - the individuals on which the experiment is done

Subjects - human experimental units

Explanatory variable/factor - independent variable that influences the response

Response variable - dependent variable that is the outcome of the experiment

Level - a specific value of a factor

Treatment - a specific experimental condition applied to the units; formed by finding all possible combinations of the levels

Vocabulary of Experiments, cntd.

Control Group - group of units used for comparison; receives no experimental treatment (no change from status quo)

Lurking variables - extraneous variables that are not being studied but have an effect on the outcome of the experiment

Placebo - a dummy treatment that has no physical effect on the subjects

Placebo effect - a psychological effect to a placebo. Many patients will respond favorably to any treatment at all, including a placebo.

Blind experiment - an experiment in which the participants do not know what treatment they receive

Double blind experiment - an experiment in which neither the participants nor the people who have contact with them know which treatment a subject received

Example

A statistics teacher wants to see if playing classical music during tests and/or changing the test format (to all multiple choice or all short answer) will result in improved test scores.

1. What are the **experimental units**?
2. What is/are the **factor/s**?
3. Identify the **levels** of all factors.
4. What is/are the **response variable/s**?
5. How many **treatments** should be used? Identify them.

Example, cntd.

6. Is there a **control group** in this experiment? If so, identify it.

7. Can this experiment be conducted in a **blind or double blind** manner? Explain.

8. **Outline** this experiment in a **diagram**.

Example 2

A research company is interested in the effects that diet medications (drugs A and B) and regular exercise have on weight loss. A group of 240 volunteers who are classified as being overweight is recruited. After receiving treatment for six months, the weight loss (in percent of total weight) will be compared.

- a.) Should this study be conducted as an **experiment** or an **observational study**? Why?

- b.) Suppose one group of volunteers receives drug A and exercises regularly, and the other group receives drug B and does not exercise. Is this a good design for the study? Why or why not?

c.) Identify the following for this scenario:

Experimental units -

Explanatory variable/factor -

Response variable -

Levels -

Treatments -

Control Group -

Blind / Double Blind -

3 Types of Experimental Designs

- 1. Completely Randomized Design** - all experimental units are allocated at random among all the treatments
- 2. Block Design** - experimental units are grouped by a common trait before being randomly assigned a treatment; randomization is carried out separately within each block
- 3. Matched Pairs Design** - special type of block design in which there are two treatments; each block consists of two closely matched units (with each receiving one treatment at random) or every single experimental unit receives both treatments in random order

Example

In our example about Statistics tests, we could incorporate blocking into our experiment.

Example

Statisticians at a pharmaceutical company want to determine if a new headache medicine the company has developed relieves pain better than aspirin. Outline an experiment that will answer this question. Incorporate blocking by some reasonable characteristic.

Example

Suppose Degree has created a new formula for its men's deodorant. Researchers want to determine if it works better than the current one on the market. Outline a matched pairs experiment to answer this question.

3 Principles of Experimental Design

1. **Control** - limit the effects of lurking variables
2. **Randomization** - the use of chance to assign units to treatments
3. **Replication** - use many experimental units to confirm the results

Experimental Design Problems

1. Suppose you want to study whether an SAT coaching program actually helps students to score higher on the SAT, so you gather data on a random sample of students who have attended the program. Suppose you find that 95% of the sample scored higher on the SAT after attending the program than before attending the program. Moreover, suppose you calculate that the sample mean of the improvements was a substantial 120 points.

a.) Explain why you cannot legitimately conclude that the SAT coaching program caused these students to improve on the test. Suggest some other explanations for their improvement.

b.) Identify the explanatory and response variables in the SAT coaching study.

c.) Is the SAT coaching study as described above a controlled experiment or an observational study? Explain.

SIMULATION PROBLEM 1.tif