

<p>Observational Studies no intervention no treatment</p> <div data-bbox="231 884 654 1064" style="border: 1px solid black; padding: 5px;"><p>Surveys knowingly respond</p></div>	<p>Experimental Studies Experiments intervention or treatment</p>
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In observational studies or surveys,

select randomly so the sample represents the population

In experiments,

assign treatments randomly to evenly distribute variables that we can't control

When: 1747

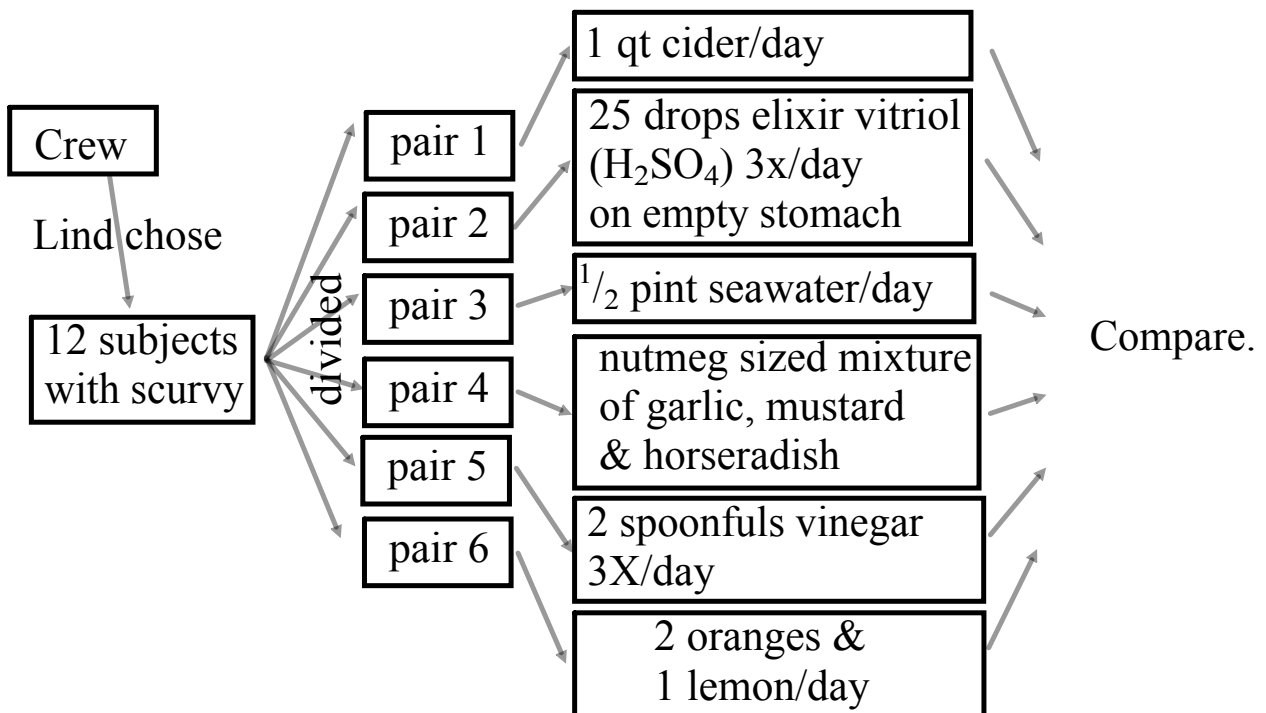
Where: The HM Bark Salisbury

Who: James Lind, the ship's surgeon

What: Used a controlled experiment on pairs of crew members who "were as similar as I could have them" to develop a cure for scurvy.

How: 2 week treatment as follows:





Result: The men given citrus fruits recovered dramatically within a week. One returned to duty after 6 days & the other became nurse to the rest. The others experienced some improvement, but nothing was comparable to the citrus fruits, which were proved to be substantially superior to the other treatments.

Control	Lind provided strict entry requirements to reduce extraneous variation.
Replication	The men were paired, which provided replication.
Randomization	From a modern perspective, the main thing that is missing is randomized allocation of subjects to treatments.

The vocabulary of experiments

Experimental Units: Objects we experiment on.

Subjects: Human experimental units.

Factor = Explanatory/Independent Variable you manipulate

Level = value, amount, or subdivision of each Factor (a Factor *can* have an absent level)

Treatment = Each Factor/Level combination, specific experimental condition applied to units

Outcome = Response/Dependent Variable (what you measure on units)

Single-Blind = when either subjects or evaluators don't know which group subjects were assigned to.

Double-Blind = when neither subjects nor evaluators don't know which group subjects were assigned to.

Placebo = treatment (in medical studies) contains no medication, used in "blind" studies.

Placebo Effect = when placebo affects response variable

control group: receives no treatment or a placebo
(to control effect of outside variables)

this avoids **experimental bias**
(such bias favors some outcome)

You're now ready to try p. 293
exercises 31, 33, & 35

Three major principles of experimental design:

- Control (use units that are similar)
- Randomization (assign treatments randomly)
- Replication (experiment on several units)

Control any variables you can.

Randomize to even out those you can't.

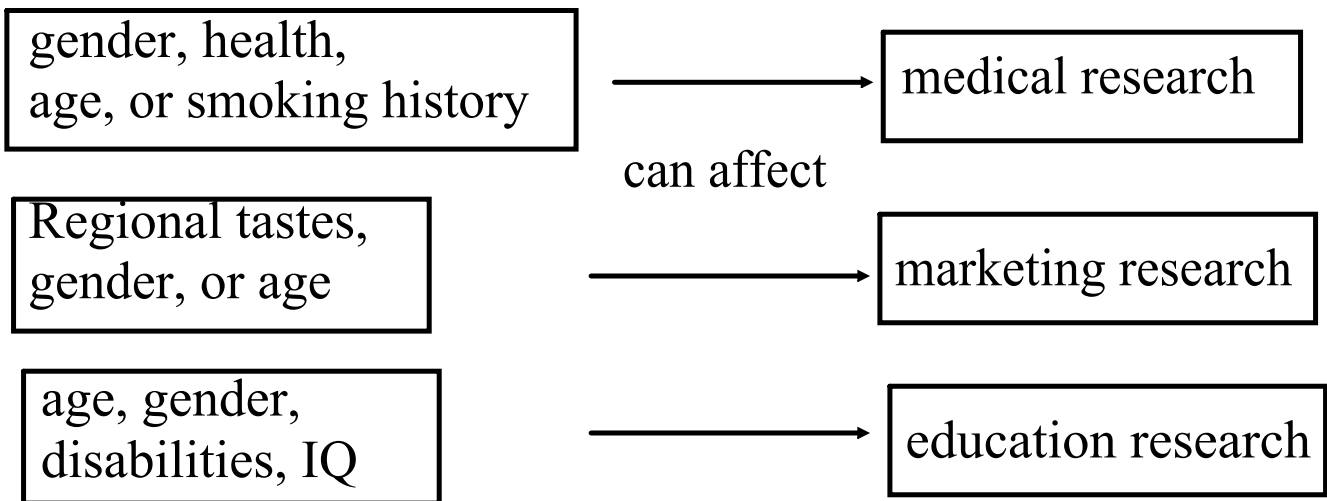
Replicate so that patterns in data are noticeable.

Control potential confounding variables that might affect response variable. Control those by using block design or matched-pairs design.

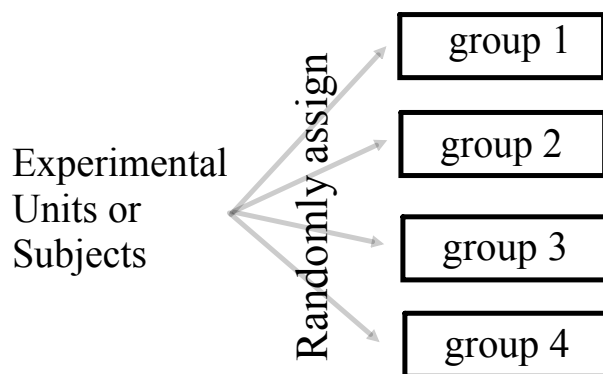


controlling
and
comparing

examples



Randomize to balance any unexpected or unconsidered variables evenly among all groups!



Replicate to identify patterns.

Individual results are just anecdotes.

Large numbers of experimental units reduce chance variation.

Medications are not tested for safety and effectiveness on just two subjects!

McDonald's would not offer a Basil-Okra Sundae based on market research of only 9 people.



+



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Because of



Control



Randomization



Replication

Differences
among groups
must be due to

treatment or chance

Principles of Experimental Design

1. **Control** the effects of lurking variables on the response, most simply by **comparing** two or more treatments.



2. **Randomize**-- use impersonal chance to assign experimental units to treatments.



3. **Replicate** each treatment on many units to reduce chance variation in the results.



An observed effect so large that it would rarely occur by chance is called **statistically significant**.

Three Experimental Designs you need to know:

1. Completely Randomized

- random assignment to treatments

2. Randomized Block

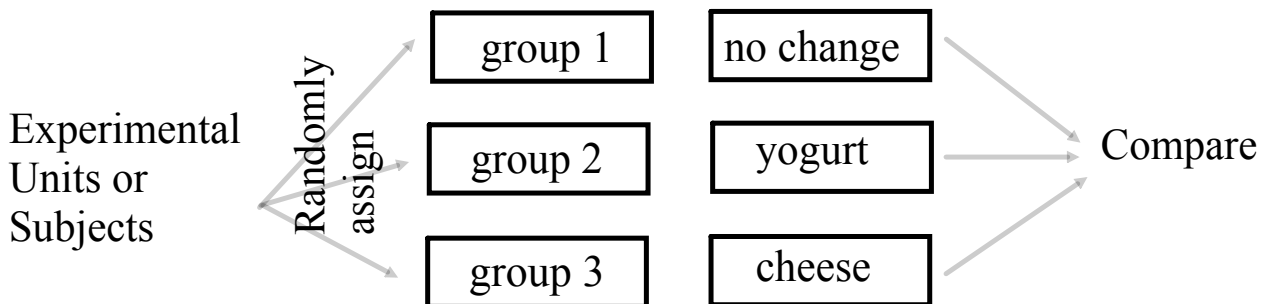
- first separate into "blocks" with similar characteristics
- run mini-experiments in each block

3. Matched Pairs

- before & after experiment or other pairing of similar units

Completely Randomized

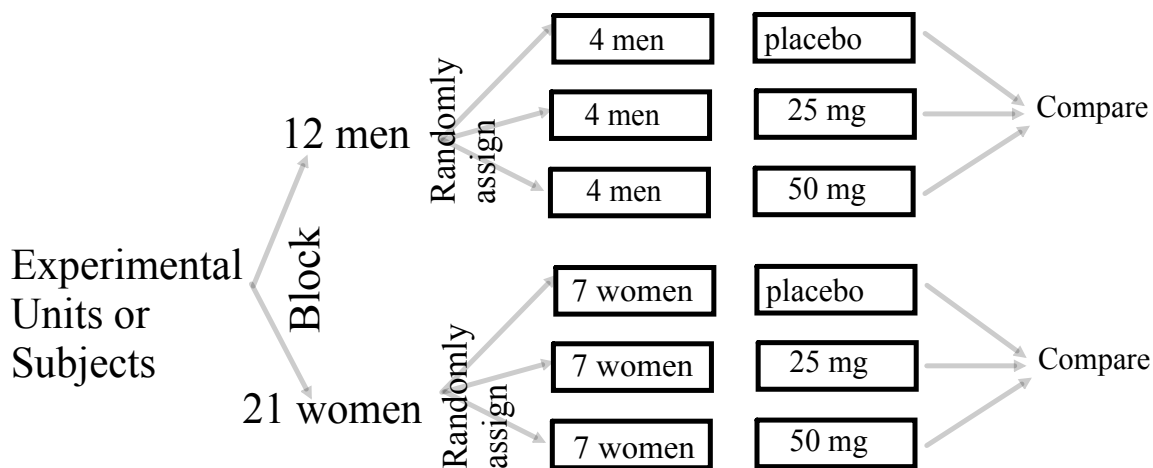
Does yogurt help prevent the body from absorbing fat? A study randomly assigned subjects to one of 3 groups. One group had no dietary changes, the second group added 2 cups of yogurt to their diet each day, & the third group added 2 ounces of cheese to their diet each day. Researchers collected stool from all subjects throughout the month-long study and compared the amount of fat excreted (and therefore not absorbed) for the 3 groups.



You're now ready to try p. 298
exercises 37, 39, & 41

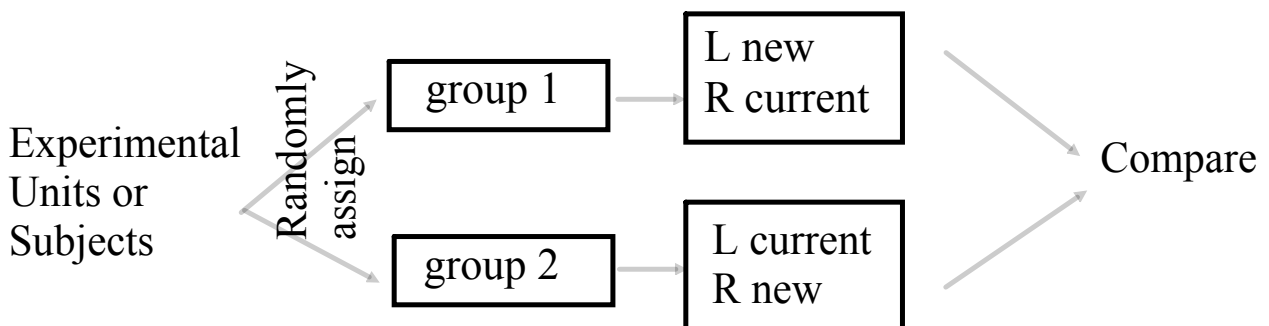
Randomized Block

Researchers are testing a new cholesterol-lowering drug on 24 volunteers, 12 men and 21 women. There is reason to believe that the drug may affect men and women differently, so they block on gender. Half the men and half the women are randomly assigned to each of 3 groups. One group gets a placebo, the other 2 groups get 1 of 2 different doses of the drug.



Matched-Pairs

Textile researchers have developed a new fabric that insulates better than a currently popular fabric used in gloves. However, they want to see if the new fabric wears as well when woven as thin as the current fabric. For 3 winter months, 60 volunteers in Fond du Lac, Wisconsin are given a pair of gloves each. Randomly within each pair, one is made of the new fabric and one of the current fabric. After 3 months, the gloves are examined for wear.



You're now ready to try p. 303
exercises 43, 45, & 47