Designing Experiments

Part 2

Statistical Significance

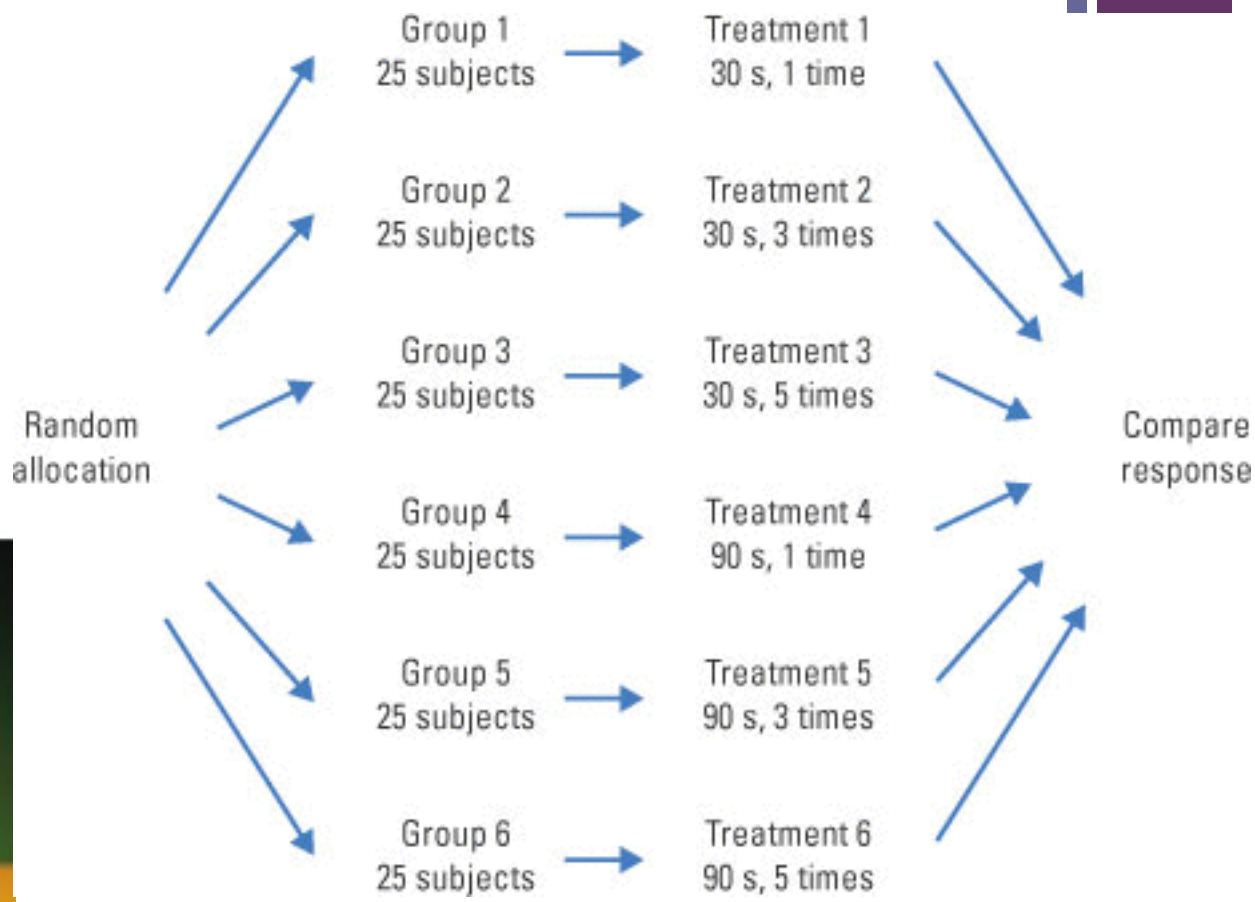
- An observed effect so large that it would rarely occur by chance is called **statistically significant.**

Completely Randomized Design

- When all experimental units are allocated at random among all treatments.
  - The Physicians Health Study (aspirin) used a completely randomized design that assigned 5499 of the 21,996 subjects to each of the four treatments.
  - Completely randomized designs can compare any number of treatments.
  - The treatments can be formed by levels of a single factor or by more than one factor.

Example 5.19 (3rd edition)– TV AD Exp. Design

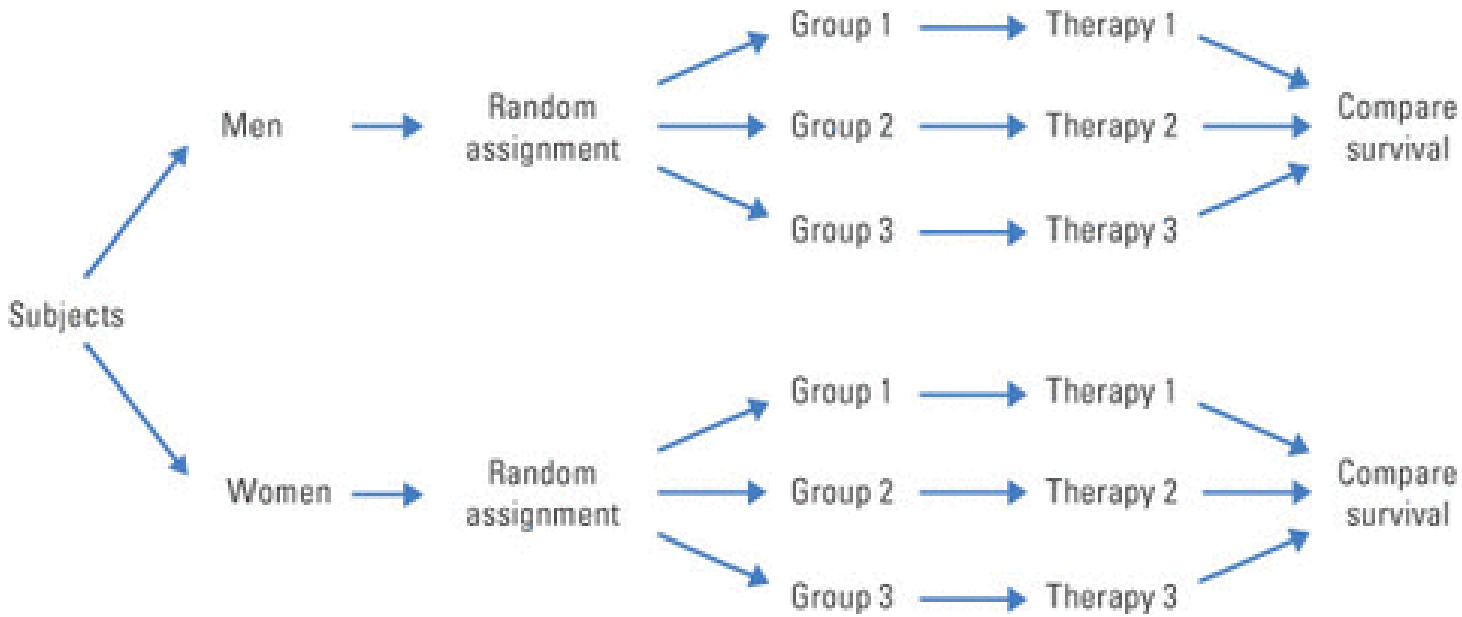
randInt(1,150,25)



Block Design

- A **block** is a group of experimental units or subjects that are known before the experiment to be similar in some way that is expected to systematically affect the response to the treatments.
- In a **block design,** the random assignment of units to treatments is carried out separately within each block.
- Another form of **control**…basically working *with* outside variables instead of *against* them.

Example 5.17 – Cancer Therapies



<u>Note:</u> Form blocks based on the most important unavoidable sources of variability among the experimental units.

Matched Pairs Design

- Sometimes completely randomized designs are inferior to more elaborate statistical designs.
- Matching subjects in various ways can produce more precise results than simple randomization.
- A **matched pairs design** compares <u>two</u> treatments given to pairs of similar subjects.
- Subjects may be paired with themselves.

Example 5.23 (3rd edition)– Driving and Talking, part II

Example 5.16 – Cereal Leaf Beetles

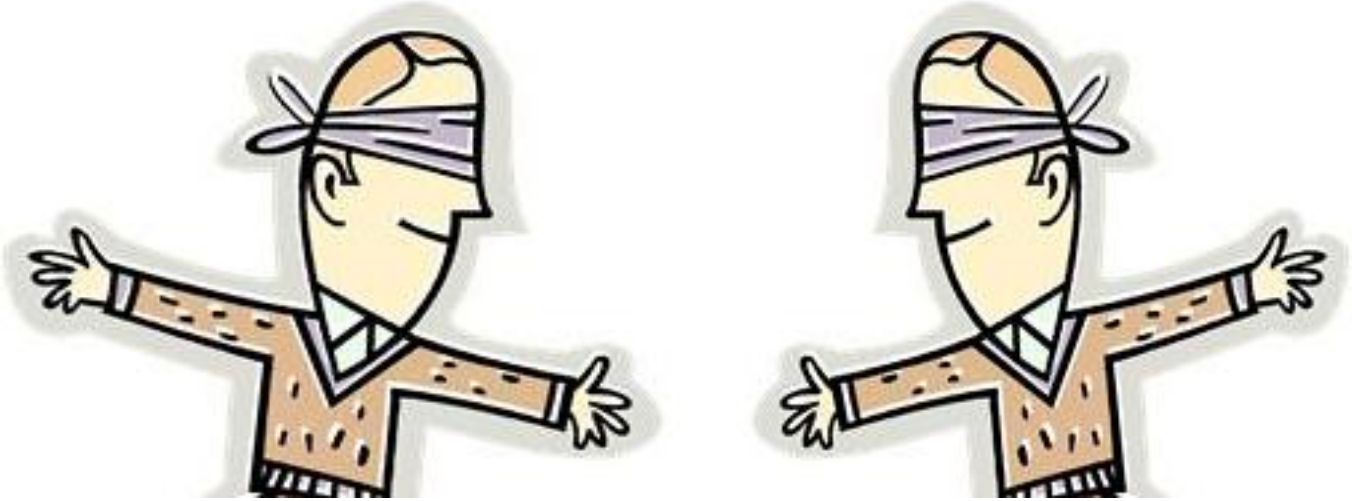
http://en.wikipedia.org/wiki/Cereal_leaf_beetle

Matched Pairs Design

- So in matched pairs design, **each pair is a block**.
- The order or type of treatment in each pair can be determined by flipping a coin.

Double-Blind Experiment

- In a **double-blind experiment,** neither the subjects nor those who measure the response variable know which treatment a subject received.



Weakness in Experiments

- Most experiments will have some weakness.
- Convincing evidence usually requires that a number of studies in different places with different details produce similar results.
- The most serious potential weakness of experiments is ***lack of realism.***

Example 5.25 (3rd edition)– Effects of Marijuana

Example 5.27 (3rd edition)– Genes and Behavior

Weakness in Experiments

- Most experimenters want to generalize their conclusions to some setting wider than that of the actual experiment.
- **Statistical analysis of an experiment cannot tell us how far the results will generalize to other settings.**
- Still, the randomized comparative experiment is one of the best things we've got to give evidence of cause and effect.