Designing Experiments to Reduce Variability

Difference Between Treatments

- In order to believe and even show that treatments make a difference, there must be a *difference between treatments* that is large enough to eliminate concern about variation within treatments

Difference Between Treatments

- In order to believe and even show that treatments make a difference, there must be a *difference between treatments* that is large enough to eliminate concert about variation within treatments
- Good experimental design plan
  - Eliminate/reduce within-treatment variability

Difference Between Treatments

- In order to believe and even show that treatments make a difference, there must be a *difference between treatments* that is large enough to eliminate concert about variation within treatments
- Good experimental design plan
  - Allow one to *measure* any variability that cannot be eliminated

Protocol

- A protocol is a careful description of exactly how the experiment is to be performed
  - A set of rules to follow
  - A list of steps to perform

Protocol

- A protocol is a careful description of exactly how the experiment is to be performed
- Must
  - Identify sources of within-treatment variability
    - Must know the situation very well

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- What are the units?
- What is the sample size?
- Experimental or observational?

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- **What are some sources of variability?**

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- What are some sources of variability?
  - Some dorms may have less healthy atmosphere (stuffy, contaminated drinking fountain, dirty bathrooms)

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- What are some sources of variability?
  - Health of student groups vary (athletes, partiers, studiers)

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- **What is the point of randomization, to eliminate within-treatment variability or to equalize it between treatments?**

- The college health service at a small college wants to see if putting antibacterial soap in the dormitory bathrooms will reduce the number of visits to the infirmary. In all 1800 student from 20 dormitories participate. Half the dormitories, chosen at random, are supplied with the special soap; the remaining ones are supplied with regular soap. At the end of the semester, the two groups of students are compared, using the average number of visits to the infirmary per person per semester.

- What is the point of randomization, to eliminate within-treatment variability or to equalize it between treatments?
  - To equalize variation between treatments

Completely Randomized Design

- Treatments assigned completely at random without prior sorting or restrictions
- Use a chance device to randomly assign a treatment to each experimental unit

Randomized Paired Comparison Design

- For a randomized paired comparison design,
  - First, sort the experimental units into pairs of similar units
  - Randomly decide which unit of each pair is assigned to which treatment

Blocks

- Blocks are groups of similar units

Randomized Block Design

- For a randomized block design,
  - First, sort/subdivide the experimental units into blocks (groups of similar units)
  - Randomly assign treatments to each unit within the blocks separately

Basic Experimental Designs

- Random assignment of treatments
  - Completely randomized design
    - Random assignment to treatments while keeping number of units as equal as possible

Basic Experimental Designs

- Random assignment of treatments
  - Randomized block design
    - Create blocks (groups of similar units) and randomly assign units in the blocks to treatments