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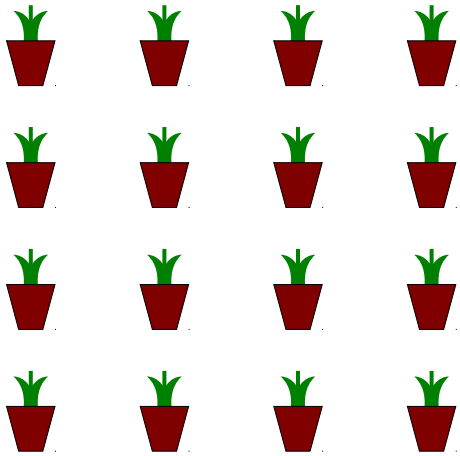
Introduction to experimental design: exercises

1 Soil moisture



Exercise 1: soil moisture experiment

An experiment was conducted to study the effects of three soil moisture levels on gene expression in maize seedlings (see Figure 1). A total of 36 seedlings were grown in 12 pots with 3 seedlings in each pot. The 3 soil moisture levels (low, medium, and high) were randomly assigned to the 12 pots with 4 pots for each soil moisture level. After three weeks, RNA was extracted from the above-ground tissues of each seedling. Each of the 36 RNA samples was hybridized to a microarray slide to measure gene expression.

1. Name the treatments in this experiment.

2. Name the experimental units in this experiment.

3. Name the observational units in this experiment.

4. Name the response variable or variables in this experiment.

2 Plants

Establish a strategy to assign to 8 plants to either of two treatments completely at random.

3 Puppies

An investigator wants to examine the effectiveness of 2 drugs A and B for controlling heartworms in puppies. Veterinarians gave conjectures that the effectiveness of the drugs may depend on a puppy's diet. Three different diets are combined with the two drugs. Also, the effectiveness of the drugs may depend on a transmitted inherent protection against heartworm obtained from the puppy's mother. We consider 4 litters, with 6 puppies in each litter.

1. What are the factors in this experiment, how many treatments are compared?

2. What is the blocking factor?

3. Describe the design in a table.

4 Dairy cattle

Suppose an experiment is to be conducted to study the effects of 5 treatments (A, B, C, D, and E) on gene expression in dairy cattle. A total of 25 lanes (on one chip) and a total of 25 cows, located on 5 farms with 5 cows on each farm, are available for the experiment.

- Design 1: To reduce variability within treatment groups, randomly assign the 5 treatments to the 5 farms so that all 5 cows on any one farm receive the same treatment. Measure gene expression using one lane for each cow.
- Design 2: Randomly assign the 5 treatments to the 5 cows within each farm so that all 5 treatments are represented on each farm. Measure gene expression using one lane for each cow.

For each design, answer the following questions

1. Represent the design in a table.

2. Name the observational units in each design.

3. Name the experimental units in each design.

4. Is blocking used for either design? If so, describe the blocks.

5. Describe the level of replication for each experimental design.

6. Which of the following designs is better from a statistical standpoint?