

Experimental Designs

Section 1.4

Statistics, MATH 181

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Census

- If we choose to use data from the entire population, we would have a *census*.
 - **Benefit**
 - Accurately reflects all members of the population.
 - **Downfall**
 - Can be time-consuming and expensive.
- Information about the population can also be obtained by sampling and experimentation.
 - Sections 1.2 & 1.3 focused on sampling strategies and principles.
 - This section focuses on experimentation.

Not just a bunch of lab rats



- In a designed experiment, the individuals or items that are used in the experiment are called ***experimental units***.
- When the experimental units are human, they are called ***subjects*** instead of experimental units.

Principles of Experimental Designs

- There are three basic principles of experimental design that we must consider:
 - **Control**
 - Two or more treatments should be compared, typically including a group that receives **no** treatment, to compare the effects of each treatment.
 - Each experimental condition is called a ***treatment***.
 - **Randomization**
 - The experimental units should be randomly divided into groups to avoid unintentional selection bias in constructing the groups.
 - **Replication**
 - A sufficient number of experimental units should be used to ensure that differences between the treatments can be detected.

Placebo

- A common experimental situation involves a specified treatment and a ***placebo***.
- A ***placebo*** is an inert (non-active) or innocuous medical substance.
- The group receiving the treatment that is being investigated is called the ***treatment group***, because they receive a legit treatment.
- The group receiving the placebo (or receiving no treatment) is called the ***control group***.

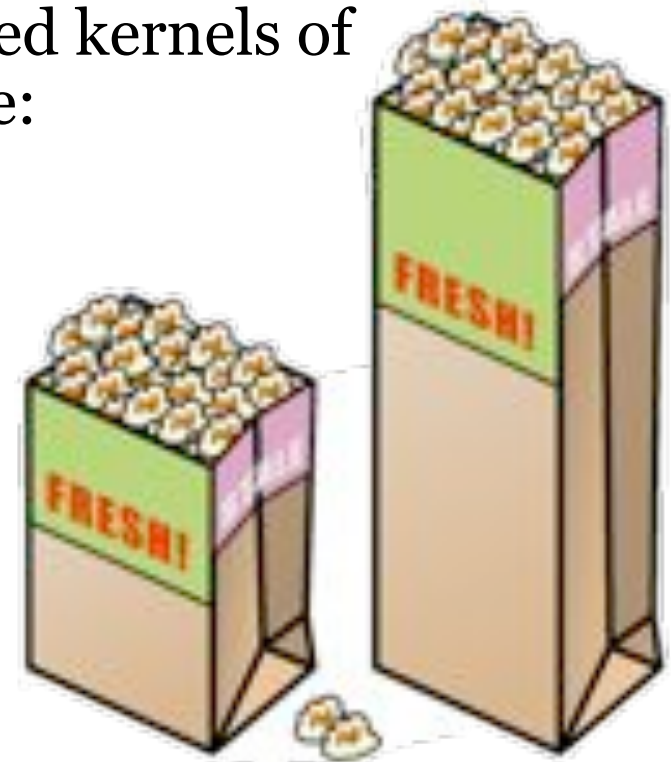


Terms for Experimental Designs

- **Response variable**: the characteristic of the experiment's outcome that is being measured or observed.
- **Factor**: a variable whose effect on the response variable is of interest to the results of the experiment.
- **Levels**: the possible values of the factor.
- **Treatment**: Each experimental condition.
 - For one-factor experiments, the treatment levels are the levels of the single factor.
 - For multifactor experiments, each treatment is a combination of levels of the factors.

Microwave Popcorn: Constructing a Study

- If we wanted to construct an experimental study about the amount of unpopped kernels of popcorn, give some examples of the:
 - Experimental units
 - Response variable
 - Factor(s)
 - Level(s) of each factor
 - Treatment(s)



Microwave Popcorn Example, Continued

- Experimental units
 - Different brands of popcorn, different brands/sizes of microwaves
- Response variable
 - Percent of un-popped kernels per bag of popcorn
- Factor(s)
 - Brand/ flavor of popcorn and microwave size (wattage)
- Level(s) of each factor
 - Would depend on microwaves and selected popcorn samples
- Treatment(s)
 - Each combination of popcorn brand or flavor matched up with every type of microwave used in the study

Example 1

(Pg. 29, Exercise 1.63)

- Supermarkets are interested in strategies to increase temporarily the unit sales of a product. In one study, researchers compared the effect of display type and price on unit sales for a particular product. The following display types and pricing schemes were employed:
 - **Display types:** normal display space interior to an aisle, normal display space at the end of an aisle, and enlarged display space.
 - **Pricing schemes:** regular price, reduced price, and cost.



Example 1, Continued

- From the previously described designed experiment, the following display types and pricing schemes were employed.
 - **Display types:**
 - normal display space interior to an aisle (NA),
 - normal display space at the end of an aisle (NE),
 - and enlarged display space (ES).
 - **Pricing schemes:**
 - regular price (Reg.),
 - reduced price (Red.),
 - And cost (Cost).
- Based on the description of the designed experiment, identify the:
 - *Experimental units*
 - Batches of the product being sold
 - *Response variable*
 - Unit sales of the product
 - *Factor(s)*
 - Display type and pricing scheme
 - *Levels of each factor*
 - Display type: NA, NE, and ES
 - Pricing schemes: Reg., Red., and Cost.
 - *Treatments*
 - Each combination of display and pricing: NA-Reg, NA-Red, NA-Cost, NE-Reg, NE-Red, NE-Cost, ES-Reg, ES-Red, and ES-Cost.

Statistical Designs

- In a ***completely randomized design***, all the experimental units are assigned randomly among all the treatments.
 - This type of design is commonly used and simple, but is not always the best design.
 - There may exist lurking variables, or hidden bias, that might influence the response variable.
- In a ***randomized block design***, the experimental units are assigned randomly among all the treatments separately within each block.
 - Similar to stratified random sampling, this design allows a potential bias to be removed by blocking the variation caused by a lurking variable.
 - Example: separating golfers by gender before analyzing the performance of a particular golf ball's driving distance.

Assessment

Pgs. 29-30:

#'s 1.63, .64, .66, .67