



Introductory Statistics

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Mathematical Sciences



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SMART SOLUTIONS FOR INNOVATIVE DAIRIES



Introductory Statistics

Population and Sample

Population

The set of all individuals (sometimes defined as measurements) of interest to the researcher.

Sample

The observed set of individuals (sometimes defined as measurements) from the population

Parameter: An unknown population characteristic of interest.

μ - population average
 σ^2 - population variance
 σ - population standard deviation

Statistic: A sample characteristic of interest.

\bar{y} - sample average
 s^2 - sample variance
 s - sample standard deviation



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Population vs. Sample Example

Selecting the proper diet for shrimp or other sea animals is an important aspect of sea farming. A researcher wishes to estimate the mean weight of shrimp maintained on a specific diet for a period of 6 months. One hundred shrimp are randomly selected from an artificial pond and each is weighed.

- Population: *the weights of all shrimp on a specific diet*
- Parameter(s) of interest: *the average weight of all shrimp on a specific diet*
- Sample: *the weights of 100 shrimp on a specific diet*
- Statistic(s) of interest: *the average weight of 100 shrimp on a specific diet*



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- What is an experimental unit?
- What is an observational unit?



Introductory Statistics Experimental Design Lingo

- **Experimental Units:** the object or individual to which a treatment is randomly and independently assigned.
- **Observational Units:** the object or individual on which the response of interest is measured.
- **Response Variable:** the characteristic that is measured.
- **Factor:** a variable used to explain variation in the response variable that takes on two or more values.
- **Levels:** the values that a factor can take on.
- **Treatments:** The levels of a single factor or the combination of the levels of several factors.

Response: ht of plant

Factor: Variety

Levels: A, B, C



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Main Experimental Design Concepts

- **Control:** control influential variables on the response
 - Extraneous factors that we have some control over
 - Other factors that we may not have control over can be treated as blocks.
- **Randomization:** Assign treatments to subjects randomly.
- **Replication:** Assess the same treatment on multiple subjects to assess subject-to-subject variation. *obtain reliable estimates of the treatment effect*
 - Pesticide A is compared with Pesticide B. Two benches are set up in a greenhouse and 10 plants are placed on each bench.
 - ① – Pesticide A is used for the 10 plants on one bench and Pesticide B is used for the 10 plants on the other bench.
 - ② – Pesticide A is used for 10 randomly selected plants on either bench. Pesticide B is used for the remaining 10 plants.



Introductory Statistics Replication Continued



No replication of each pesticide

Replication

Confounding between treatment and bench

Technical replicate: repeated measurement of the same sample (pseudo-replication)

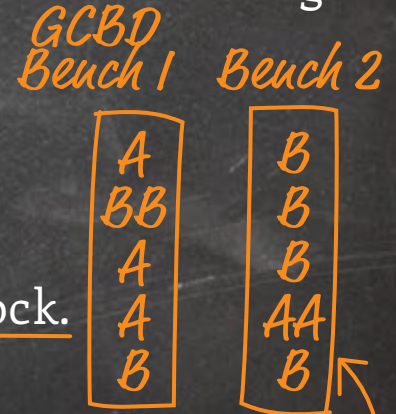
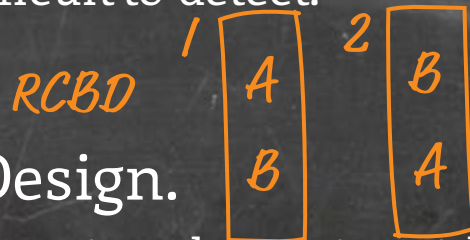
Biological replicate: measurements are taken from several independent individuals rather than from a single



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Types of Scientific Studies

- Completely Randomized Design. $t=2$ A,B
 - Used to compare t treatments.
 - All experimental units are allocated at random among all of the t treatments.
 - A disadvantage of this type of experiment is that if differences exist among the experimental units that affect the response, differences among the treatments will be difficult to detect.



- Randomized Block Design.
 - Treatments are randomly assigned to units within each block.
 - Every treatment occurs in every block.
 - A disadvantage of this type of experiment is that block-to-block comparisons cannot be made (unless blocks are replicated and selected at random).

Replicating with my bench



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