Section 1.4 Experiments

Stats 7 Summer Session II 2022

Principles of experimental design

1. **Control**: Compare treatment of interest to a control group.
2. **Randomize**: Randomly assign subjects to treatments, and randomly sample from the population whenever possible.
3. **Replicate**: Within a study, replicate by collecting a sufficiently large sample. Or replicate the entire study.
4. **Block**: If there are variables that are known or suspected to affect the response variable, first group subjects into blocks based on these variables, and then randomize cases within each block to treatment groups.

Practice

A study is designed to test the effect of light level and noise level on exam performance of students. The researcher also believes that light and noise levels might have different effects on males and females, so they want to make sure both sexes are equally represented in each group. Which of the below is correct?

A. There are 3 explanatory variables (light, noise, sex) and 1 response variable (exam performance)

B. There are 2 explanatory variables (light and noise), 1 blocking variable (sex), and 1 response variable (exam performance)

C. There is 1 explanatory variable (sex) and 3 response variables (light, noise, exam performance)

D. There are 2 blocking variables (light and noise), 1 explanatory variable (sex), and 1 response variable (exam performance)

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B.   *There are 2 explanatory variables (light and noise), 1 blocking variable (sex), and 1 response variable (exam performance)*

C.   There is 1 explanatory variable (sex) and 3 response variables (light, noise, exam performance)

D.   There are 2 blocking variables (light and noise), 1 explanatory variable (sex), and 1 response variable (exam performance)

Difference Between Blocking and Explanatory Variables

- Factors are conditions we can impose on the experimental units.

- Blocking variables are characteristics that the experimental units come with, that we would like to control for.

- Blocking is like stratifying, except used in experimental settings when randomly assigning, as opposed to when sampling.

More Experimental Design Terminology...

- Placebo: fake treatment, often used as the control group for medical studies

- Placebo effect: experimental units showing improvement simply because they believe they are receiving a special treatment

- Blinding: when experimental units do not know whether they are in the control or treatment group

- Double-blind: when both the experimental units and the researchers who interact with the patients do not know who is in the control and who is in the treatment group

Practice

What is the main difference between observational studies and experiments?

A. Experiments take place in a lab while observational studies do not need to.

B. In an observational study we only look at what happened in the past.

C. Most experiments use random assignment while observational studies do not.

D. Observational studies are completely useless since no causal inference can be made based on their findings.

Practice

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Random Assignment vs. Random Sampling

	Random assignment	No random assignment	
Random sampling	Causal conclusion, generalized to the whole population.	No causal conclusion, correlation statement generalized to the whole population.	Generalizability
No random sampling	Causal conclusion, only for the sample.	No causal conclusion, correlation statement only for the sample.	No generalizability
	Causation	Correlation	

ideal experiment

most observational studies

most experiments

bad observational studies