Chapter 1 - Statistical Sleuth

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Motivation and Creativity

Study Objective and Setup

1. Study objective: evaluate whether rewards promote creativity
2. Study setup: experienced creative writers randomly assigned to one of two treatment groups (Treatment 1: "intrinsic" group; Treatment 2: "extrinsic group"); each group filled out a questionnaire
    - "Intrinsic" group: completed a questionnaire that focuses on reasons for writing that bring pleasure
    - "Extrinsic" group: completed a questionnaire that focuses on reasons for writing that bring a reward

Study Type and Implications

1. What kind of study is this?

   A randomized experiment
2. How do you know?

   Subjects are randomly assigned to treatment groups. How might this random assignment be completed?
3. Participants each wrote a poem in the Haiku style about laughter. What is the purpose of controlling the subject and poem style?

   Subject and poem style would be potential confounding variables.
4. Judges were not told the purpose of the study before evaluating the poems. Why might this be important?

   Blinding - judges might have preconceptions about how the type of motivation impacts creativity
5. Does this study allow us to draw a causal conclusion about the relationship between motivation and creativity in this study?

   Yes, it does, in the context of this study, because it is a randomized experiment.

Inference to Populations

1. How are subjects selected, *randomly sampled* or *self-selected*?

   Self-selected
2. In which case can inferences to populations be drawn?

   When they are randomly sampled, because then all subpopulations are represented in the sample in roughly the same mix as in the overall population.
3. What is an example of a type of random sampling?

   Simple random sampling - ask what this means

Measuring Uncertainty

1. Probability Model

   - Additive treatment effect model
   - Y: creativity score after exposure to the extrinsic questionnaire
   - Y^*: creativity score after exposure to intrinsic questionnaire
   - Model: $Y^* = Y + \delta$; δ is the treatment effect; unknown

2. Null and Alternative Hypotheses

   - Question: Is there are treatment effect?
   - $H_0: \ \delta = 0$
   - $H_A: \ \delta \neq 0$

3. Test Statistic

   - Statistic: numerical quantity that arises from the data (e.g., sample mean or average)
   - Here, $d = \bar{Y}_2 - \bar{Y}_1 = 4.144$
   - Need to know if 4.144 is "close to 0" - evaluate this by generating a randomization distribution assuming no treatment effect

4. Randomization distribution

   - Idea: calculate $\bar{Y}_2 - \bar{Y}_1$ for every possible outcome of the randomization process, assuming that there is no treatment effect (under the null hypothesis)
   - A histogram of all of these outcomes would give us the randomization distribution (in this lab we had 1000 outcomes; book does 500,000)
   - p-value: probability the randomization alone leads to a test statistic as extreme or more extreme than the one observed; the smaller the value, the less likely chance assignment is responsible for the differences in the groups
   - Computing p-values from randomized experiments:
     - enumeration of all possible groupings can be overburdensome, even though it would allow us to calculate the p-value exactly
     - simulate large number of randomizations and find proportion that produce a test statistic as extreme or more extreme (what we did)
     - approximate randomization distribution of the measurements and form the test statistic (most common, and what you have seen prior to this class)
   - Randomization test based on random assignment
   - Permutation test based on random sampling