Questions about the Assignment

Interpreting correlation scores

From the GSS: EDUC and CONINC

\[ r = .39 \]

Education and Income are positively correlated. An increase in education level is associated with an increase in income level. Likewise, a decrease in education level is associated with a decrease in income level.

Hypothesis Testing I

Bootstrapping review
Random chance
Null and alternative hypotheses
Randomization distribution
p-value

Hypothesis Testing I

What is the probability that our observed outcome could have occurred by random chance?

Exercise and Gender Study

Data

Research Question: Do male students spend more time exercising than female students?
Sample (n) = 50 students
Two Variables:
Gender
# of hours spent exercising last week
Sample statistics:
\[ \bar{\mu}_M = .40 \]
\[ \bar{\mu}_F = .60 \]
\[ \bar{x} = 10.6 \text{ hours} \]
\[ \bar{x}_M = 12.4 \text{ hrs} \] (The sample mean # of hours male students spend exercising.)
\[ \bar{x}_F = 9.4 \text{ hrs} \] (The sample mean # of hours female students spend exercising.)
\[ \bar{x}_M - \bar{x}_F = 3 \text{ hrs} \] (The difference in sample means.)

Exercise and Gender Study

Hypotheses

Research Question: Do male students spend more time exercising than female students?
The null hypothesis is the claim that there is no effect or no difference.
What would be our null hypothesis for this study?
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What would be our null hypothesis for this study?
What would be our alternative hypothesis?
What would be our alternative hypothesis?

Null Hypothesis (H₀): The claim that there is no effect or no difference. (e.g., The claim that time spent exercising does not differ by gender.)

Alternative Hypothesis (H₁): The claim that we seek evidence for; usually that there is some effect. (e.g., The claim that male students spend more time exercising than female students.)
Testing Hypotheses with Evidence

The alternative hypothesis is supported by finding evidence (i.e., data) that both contradicts the null hypothesis and supports the alternative hypothesis.

We assess the strength of evidence by assuming the null hypothesis is true (e.g., that $\mu_M = \mu_F$) and determining the probability of seeing an outcome as extreme as the outcome in the observed sample (e.g., $\mu_M - \mu_F = 3$) if $H_0$ is true.

To see if a sample statistic provides evidence that both contradicts $H_0$ and supports $H_a$, we need to know what kind of sample statistics we would observe, just by random chance, if $H_0$ was true.

Exercise and Gender Study

Statistical Test

Research Question: Do male students spend more time exercising than female students?

Observed sample statistic: $\bar{x}_M - \bar{x}_F = 3$ hrs (Difference in sample means)

How unusual would it be to observe this sample statistic by random chance if the null hypothesis was true (i.e., $\mu_M - \mu_F = 0$)?

What is the probability that we would observe, by random chance, a difference in sample means as large as 3 hours if male and female students did not differ in the amount of time they spent exercising?

To answer this question we need a distribution of sample statistics that would occur if the null hypothesis was true.

We can generate these sample statistics using the randomization process.

Exercise and Gender Study

Randomization Process

The sample size of our observed sample is 50 (30 Females and 20 Males).

Imagine having 50 pieces of paper and on each piece of paper is a number which corresponds with one of the values of $x$ (i.e., the number of hours spent exercising) in the observed sample.

We want to generate samples where the null hypothesis is true (i.e., time spent exercising does not differ by gender).

To do this we can randomly assign a gender value to each piece of paper.

To be consistent with our observed sample, we’d randomly label 30 pieces “Female” and 20 pieces “Male”.

Then we would calculate the sample statistic (i.e., difference in sample means) for this randomization sample.

We would repeat this process 1,000 times to obtain 1,000 randomization sample statistics which form a randomization sampling distribution.

p-value

The p-value is the probability of getting a sample statistic as extreme as the observed sample statistic, just by random chance, if the null hypothesis is true.

The smaller the p-value, the stronger the statistical evidence is against the $H_0$ and in favor of the $H_a$.

We use the randomization sampling distribution to calculate the p-value of the observed sample statistic.

The p-value is the proportion of randomization sample statistics that are as extreme as our observed sample statistic.

Exercise and Gender Study

www.lock5stat.com/statkey/

The p-value is the proportion of randomization sample statistics that are as extreme as our observed sample statistic.

If time spent exercising did not differ by gender, we would see a sample difference as extreme as 3 hours in about 10% of our studies.
Randomization Sampling Distribution and p-value

Randomization sampling distribution: The kind of distribution of sample statistics would we get, just by random chance, if the null hypothesis is true.

p-value: The proportion of these sample statistics that are as extreme as our observed sample statistic.

Bootstrapping and Randomization

Bootstrapping resamples from our original sample to generate several bootstrap samples and form a bootstrap sampling distribution.

A bootstrap sampling distribution approximates the sampling distribution.

Randomization uses the original sample to generate samples that would be observed by random chance if H_0 was true. The sample statistics from these randomization samples form a randomization sampling distribution.

A randomization sampling distribution approximates the sampling distribution if H_0 was true.

Assignment

Part I:
4.10 and 4.20

Part II: (Type up this assignment in a Word document) [Worth 30 points]

GENDER, RACE, CONINC, EDUC, AGE, GRASS, HEALTH, DIVORCE, GUNLAW, PARTYID

Formulate a research question that uses at least two of the following GSS variables listed above.
List the variables you will use.
Indicate whether the variables are categorical or quantitative.
Provide the sample mean/sample proportion for each variable you will be using.
Identify the sample statistic you’ll be testing (you don’t have to calculate the actual value)
State your null hypothesis in words and with an equation.
State your alternative hypothesis in words and with an equation.

Characteristics of Hypothesis Tests

Hypotheses are always given in terms of population parameters.
The null hypothesis and alternative hypothesis need to represent mutually exclusive outcomes.
The null hypothesis is usually a very specific statement, which makes it straightforward to assess evidence against.
If we can’t rule out the null hypothesis, then we don’t have enough evidence to accept the alternative hypothesis.
Data can only contradict or not contradict the null hypothesis, but can never confirm it.