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Lab 6: Hypothesis Testing

Assignment 1 :Household Income in the South

Population: Cities in the Southern U.S.
Null (H_0): The average income = $32,418
Alt (H_a): The average income is less than $32,418
Test type: One-sample t-test (left-tailed)

Results:

- t = –1.6676   (df = 32)

- p-value = 0.05258

- Sample mean = 31,300.07

- 95% Confidence Interval = (–∞, 32,435.65)

Decision: We fail to reject H_0 because p = 0.05258, which is a little more than 0.05.
What it means: We don't have strong enough evidence to say incomes in the South are lower than $32,418.
Confidence level change: When I changed it to 90% or 99%, the results didn't really change the decision stayed the same.

Assignment 2 :Midwest Unemployment Rate

Population: Cities in the Midwest U.S.
H_0: Average unemployment = 6.5342%
H_a: Average unemployment > 6.5342%
Test type: One-sample t-test (right-tailed)

Results:

- t = –3.2347   (df = 34)

- p-value = 0.9986

- Sample mean = 5.6936%

- 95% Confidence Interval = (5.25%, ∞)

Decision: We fail to reject H_0 because the p-value is much bigger than 0.05.
What it means: The unemployment rate in the Midwest is not higher than the national average of 6.5342%.
Confidence interval check: 6.5342% is not inside the CI, which matches the test result.

Assignment 3 :Comparing South and Midwest Incomes

H_0: Average income in the South = Average income in the Midwest
H_a: The averages are different
Variance check: F = 1.1857, p = 0.6397 → Variances are about the same
Test type: Two-sample t-test (equal variances, two-tailed)

Results:

- t = –0.6209   (df = 68)

- p-value = 0.5368

- South mean = 31,451.70   Midwest mean = 32,078.79

- 95% Confidence Interval = (–2,642.62, 1,388.43)

Decision: Fail to reject H_0 because p > 0.05.
What it means: There's no big difference between the average incomes of the South and Midwest.

Assignment 4 -Endorphin Levels (Before vs After Running)

H_0: The mean difference = 0
H_a: The mean difference ≠ 0
Test type: Paired t-test (same people measured before and after)

Results:

- t = 22.081   (df = 10)

- p-value = 8.14×10^{-10}

- Mean difference = 0.7182

- 95% Confidence Interval = (0.6457, 0.7907)

Decision: Reject H_0 because p < 0.05.
What it means: The "after running" β-endorphin levels are much higher than before.
Confidence interval check: The CI doesn't include 0, which matches the same decision.
Even if we used 90% or 99%, the result wouldn't change because the p-value is super small.