9.E: Repeated Measures (Exercises)

1. What is the difference between a 1-sample t-test and a dependent-samples t-test? How are they alike?

Answer:

A 1-sample t-test uses raw scores to compare an average to a specific value. A dependent samples t-test uses two raw scores from each person to calculate difference scores and test for an average difference score that is equal to zero. The calculations, steps, and interpretation is exactly the same for each.

2. Name 3 research questions that could be addressed using a dependent samples t-test.
3. What are difference scores and why do we calculate them?

Answer:

Difference scores indicate change or discrepancy relative to a single person or pair of people. We calculate them to eliminate individual differences in our study of change or agreement.

4. Why is the null hypothesis for a dependent-samples t-test always $\mu_D = 0$?
5. A researcher is interested in testing whether explaining the processes of statistics helps increase trust in computer algorithms. He wants to test for a difference at the α = 0.05 level and knows that some people may trust the algorithms less after the training, so he uses a two-tailed test. He gathers pre-post data from 35 people and finds that the average difference score is $\overline{X_D}$ = 12.10 with a standard deviation of s_D= 17.39. Conduct a hypothesis test to answer the research question.

Answer:

Step 1: $H_0 : \mu = 0$ "The average change in trust of algorithms is 0", $H_A : \mu \neq 0$ "People's opinions of how much they trust algorithms changes."

Step 2: Two-tailed test, df = 34, $t*$ = 2.032.

Step 3: $\overline{X_D}$ = 12.10, $s_{\overline{X_D}}$= 2.94, t = 4.12.

Step 4: $t > t*$, Reject H_0. Based on opinions from 35 people, we can conclude that people trust algorithms more ($\overline{X_D}$= 12.10) after learning statistics, $t(34) = 4.12, p < .05$. Since the result is significant, we need an effect size: Cohen's d = 0.70, which is a moderate to large effect.

6. Decide whether you would reject or fail to reject the null hypothesis in the following situations:
   a. $\overline{X_D}$ = 3.50, s_D = 1.10, n = 12, α = 0.05, two-tailed test
   b. 95% CI= (0.20,1.85)
   c. t = 2.98, $t*$ = -2.36, one-tailed test to the left
   d. 90% CI = (-1.12, 4.36)
7. Calculate difference scores for the following data:

Time 1	Time 2	X_D
61	83	
75	89	
91	98	
83	92	
74	80	
82	88	
98	98	
82	77	

Time 1	Time 2	X_D
69	88	
76	79	
91	91	
70	80	

Answer:

Time 1	Time 2	X_D
61	83	22
75	89	14
91	98	7
83	92	9
74	80	6
82	88	6
98	98	0
82	77	-5
69	88	19
76	79	3
91	91	0
70	80	10

8. You want to know if an employee's opinion about an organization is the same as the opinion of that employee's boss. You collect data from 18 employee-supervisor pairs and code the difference scores so that positive scores indicate that the employee has a higher opinion and negative scores indicate that the boss has a higher opinion (meaning that difference scores of 0 indicate no difference and complete agreement). You find that the mean difference score is $\overline{X_D}$= -3.15 with a standard deviation of s_D = 1.97. Test this hypothesis at the α = 0.01 level.
9. Construct confidence intervals from a mean of $\overline{X_D}$ = 1.25, standard error of $s_{\overline{X_D}}$= 0.45, and df = 10 at the 90%, 95%, and 99% confidence level. Describe what happens as confidence changes and whether to reject H_0.

Answer:

At the 90% confidence level, $t*$ = 1.812 and CI = (0.43, 2.07) so we reject H_0. At the 95% confidence level, $t*$ = 2.228 and CI = (0.25, 2.25) so we reject H_0. At the 99% confidence level, $t*$ = 3.169 and CI = (-0.18, 2.68) so we fail to reject H_0. As the confidence level goes up, our interval gets wider (which is why we have higher confidence), and eventually we do not reject the null hypothesis because the interval is so wide that it contains 0.

10. A professor wants to see how much students learn over the course of a semester. A pre-test is given before the class begins to see what students know ahead of time, and the same test is given at the end of the semester to see what students know at the end. The data are below. Test for an improvement at the α = 0.05 level. Did scores increase? How much did scores increase?

Pretest	Posttest	X_D
90	89	
60	66	

95	99	
93	91	
95	100	
67	64	
89	91	
90	95	
94	95	
83	89	
75	82	
87	92	
82	83	
82	85	
88	93	
66	69	
90	90	
93	100	
86	95	
91	96	