9.4: Bad Press

Let's say that a bank wants to make sure that their new commercial will make them look good to the public, so they recruit 7 people to view the commercial as a focus group. The focus group members fill out a short questionnaire about how they view the company, then watch the commercial and fill out the same questionnaire a second time. The bank really wants to find significant results, so they test for a change at α = 0.10. However, they use a 2-tailed test since they know that past commercials have not gone over well with the public, and they want to make sure the new one does not backfire. They decide to test their hypothesis using a confidence interval to see just how spread out the opinions are. As we will see, confidence intervals work the same way as they did before, just like with the test statistic.

Step 1: State the Hypotheses As always, we start with hypotheses:

H_0: There is no change in how people view the bank

$$H_0 : \mu D = 0$$

H_A: There is a change in how people view the bank

$$H_A : \mu D \neq 0$$

Step 2: Find the Critical Values Just like with our regular hypothesis testing procedure, we will need critical values from the appropriate level of significance and degrees of freedom in order to form our confidence interval. Because we have 7 participants, our degrees of freedom are df = 6. From our t-table, we find that the critical value corresponding to this df at this level of significance is $t*$ = 1.943.

Step 3: Calculate the Confidence Interval The data collected before (time 1) and after (time 2) the participants viewed the commercial is presented in Table 9.4.1. In order to build our confidence interval, we will first have to calculate the mean and standard deviation of the difference scores, which are also in Table 9.4.1. As a reminder, the difference scores are calculated as Time 2 – Time 1.

Table 9.4.1: Opinions of the bank

Time 1	Time 2	X_D
3	2	-1
3	6	3
5	3	-2
8	4	-4
3	9	6
1	2	1
4	5	1

The mean of the difference scores is:

$$\overline{X_D} = \frac{\sum X_D}{n} = \frac{4}{7} = 0.57$$

The standard deviation will be solved by first using the Sum of Squares Table:

Table 9.4.2: Sum of Squares

X_D	$X_D - \overline{X_D}$	$(X_D - \overline{X_D})^2$
-1	-1.57	2.46
3	2.43	5.90
-2	-2.57	6.60
-4	-4.57	20.88

X_D	$X_D - \overline{X_D}$	$(X_D - \overline{X_D})^2$
6	5.43	29.48
1	0.43	0.18
1	0.43	0.18
$\Sigma = 4$	$\Sigma = 0$	$\Sigma = 65.68$

$$s_D = \sqrt{\frac{SS}{df}} = \sqrt{\frac{65.68}{6}} = \sqrt{10.95} = 3.31$$

Finally, we find the standard error:

$$s_{\overline{X_D}} = {}^{S_D} / \sqrt{n} = 3.31/\sqrt{7} = 1.25$$

We now have all the pieces needed to compute our confidence interval:

$$95\%CI = \overline{X_D} \pm t^* \left(s_{\bar{X}_D}\right)$$
$$95\%CI = 0.57 \pm 1.943(1.25)$$
$$\text{Upper Bound} = 0.57 + 1.943(1.25)$$
$$UB = 0.57 + 2.43$$
$$UB = 3.00$$
$$\text{Lower Bound} = 0.57 - 1.943(1.25)$$
$$LB = 0.57 - 2.43$$
$$LB = -1.86$$
$$95\%CI = (-1.86, 3.00)$$

Step 4: Make the Decision Remember that the confidence interval represents a range of values that seem plausible or reasonable based on our observed data. The interval spans -1.86 to 3.00, which includes 0, our null hypothesis value. Because the null hypothesis value is in the interval, it is considered a reasonable value, and because it is a reasonable value, we have no evidence against it. We fail to reject the null hypothesis.

Fail to Reject H_0. Based on our focus group of 7 people, we cannot say that the average change in opinion ($\overline{X_D}$ = 0.57) was any better or worse after viewing the commercial, CI: (-1.86, 3.00).

As with before, we only report the confidence interval to indicate how we performed the test.