Key Lab #5: Hypothesis Testing with T-Scores

Review one-sample t-test by hand: Tips: Assume you work at a restaurant and you are told that tips on the patio exceed the $2 per table you average inside. Your first patio night you earn 3,2,4,5,1,6. Can you conclude that tips on the patio will differ from inside (i.e., that there is a treatment effect)?

Hypothesis testing Steps:

1. Comparing M & μ.
2. H_0: μ = $2 H_A: μ ≠ $2
3. Use one-sample t-test, 2 tailed, α = .05

   df = n-1 = 6 -1 = 5 t-critical = ±2.571
4. Calculate t-obtained:
5. Explain outcome. Retain Ho.

   The hypothesis was not supported. Average tips on the patio (M=$3.5) did not differ significantly from normal tips (μ = $2), t(5)=1.9639, n.s.

Step 1: Get standard deviation

$$\hat{s}_x = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}} = \sqrt{\frac{91 - \frac{441}{6}}{6-1}} = 1.8708$$

Step 2: Get standard error of the mean

$$\hat{s}_{\bar{x}} = \frac{\hat{s}_x}{\sqrt{n}} = \frac{1.8708}{\sqrt{6}} = .7638$$

Step 3: Calculate t-obtained

$$t = \frac{\bar{x} - \mu}{\hat{s}_{\bar{x}}} = \frac{3.5 - 2}{.7638} = 1.9639$$

Does not exceed t_{crit} of 2.571. Retain H_0.

If you reject H_0, calculate effect size:

Not appropriate.

$$d = \frac{|\bar{x} - \mu|}{\hat{s}_x} = \frac{|3.5 - 2|}{1.8708} = .8018$$

Q1. Exercise: Do college students differ from the recommended bare minimum of 3 hours of exercise per week?: 0,6,2,3,2,4,0,0,3. ***Calculate by hand***

Hypothesis testing Steps:

1. Comparing M & μ.
2. H_0: μ = 3 hours H_A: μ ≠ 3 hours
3. Use one-sample t-test, 2 tailed, α = .05

   df = n-1 = 9 -1 = 8 t-critical = ±2.306
4. Calculate t-obtained:
5. Explain outcome. Retain Ho.

   The hyp. was not supported. Average hours of exercise by college students (M=2.2222) did not differ significantly from the recommended amount (μ=3), t(8) = -1.1393, n.s.

Step 1: Get standard deviation

$$\hat{s}_x = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}} = \sqrt{\frac{78 - \frac{400}{9}}{9-1}} = 2.0480$$

Step 2: Get standard error of the mean

$$\hat{s}_{\bar{x}} = \frac{\hat{s}_x}{\sqrt{n}} = \frac{2.0480}{\sqrt{9}} = .6827$$

Step 3: Calculate t-obtained

$$t = \frac{\bar{x} - \mu}{\hat{s}_{\bar{x}}} = \frac{2.2222 - 3}{.6827} = -1.1393$$

Within t_{crit} of 2.306. Retain H_0.

H_0 retained, effect size not appropriate:

Q2. Nightmares: Do people suffering from Post Traumatic Stress Disorder (PTSD) suffer more nightmares than the one per month of the general population? 2,1,3,2,3,1,3. ***Calculate by hand***

***Note: $\hat{s}_x$ = 0.9**

Hypothesis testing Steps:

1. Comparing M & μ.
2. H_0: μ = 1 nightmare H_A: μ ≠ 1 nightmare
3. Use one-sample t-test, 2 tailed, α = .05

   df = n-1 = 7 -1 = 6 t-critical = ±2.447
4. Calculate t-obtained:
5. Explain outcome. Reject Ho.

   The [redacted] 1), t(6)

Step 1: Get standard deviation.

Given as $\hat{s}_x$ = 0.9

Step 2: Get standard error of the mean

$$\hat{s}_{\bar{x}} = \frac{\hat{s}_x}{\sqrt{n}} = \frac{0.9}{\sqrt{7}} = 0.3402$$

Step 3: Calculate t-obtained

$$t = \frac{\bar{x} - \mu}{\hat{s}_{\bar{x}}} = \frac{2.1429 - 1}{0.3402} = 3.3595$$

Exceeds t_{crit} of 2.447. Reject H_0.

H_0 rejected, so calculate the effect size:

$$d = \frac{|\bar{x} - \mu|}{\hat{s}_x} = \frac{|2.1429 - 1|}{0.9} = 1.2699$$

= 3.361, p≤.05. The effect of PTSD on nightmares was large, d = 1.2699.

Review one-sample t-tests on SPSS: Use your **two** SPSS guides to do **two** one-sample t-tests with SPSS. Enter both sets of data (from the Retain and Reject handouts) and notice how small changes in the values can lead to different outcomes. Notice how the paragraph explanations change across the two handouts.

Q3. Cancers: Do people who live near coal-fired power plants have different cancer rates than the normal rate of 15 per 1000 residents? 20,28,25,42,24,25,37,15,20,15,10. ***Calculate on SPSS***

$$d = \frac{|\bar{x} - \mu|}{\hat{s}_x} = \frac{23.73 - 15}{9.488} = .9201$$

Hypothesis testing Steps:

1. Comparing M & μ.
2. H_0: μ = 15 H_A: μ ≠ 15
3. Use one-sample t-test, 2 tailed, α = .05

   [t-critical not needed when using SPSS]
4. Calculate t-obtained:
5. Explain outcome. Reject Ho.

The hyp. was supp. Average cancer rate near coal plants (M = 23.73) significantly exceeds normal rate (μ = 15), t(10) = 3.051, p≤.05. The effect of proximity on cancer was large, d = .9201

Sketch the two boxes of SPSS output*. Label values with appropriate symbols (e.g., M, μ). Ignore Confidence Intervals.*

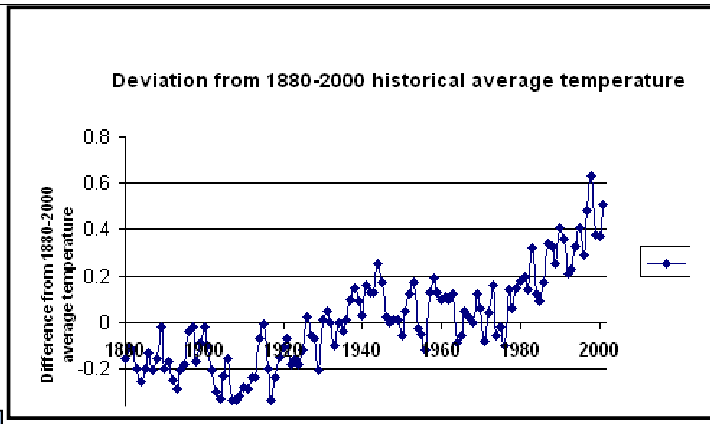
One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Cancers	11	23.73	9.488	2.861

One-Sample Test

	Test Value = 15			
	t	df	Sig.	Mean Diff
Cancers	3.051	10	.012	8.727

Q4: To determine if global warming is occurring, scientists must distinguish between random fluctuations in temperature and distinct trends. Until recently, annual temperature changes appeared relatively random. But in the 1990s a more reliable pattern appeared. *Be very afraid!* **For each decade of data test whether the annual changes in global temperature differ significantly from an average change of zero**. Note: *You can skip the hypothesis testing steps. Just provide the final write-up paragraph for each [Hint: You should get a t-obtained equal to 1.141 for the 70's and 9.588 for the 90s.*



Hint: Use zero for μ

1970	0.06
1971	-0.08
1972	0.04
1973	0.16
1974	-0.06
1975	-0.02
1976	-0.1
1977	0.14
1978	0.06
1979	0.15

Average changes in global temperature in the 70's ...

Th[illegible]350) d[illegible] (μ=0), t (9) = 1.141, n.s.

1990	.41
1991	.36
1992	.21
1993	.23
1994	.33
1995	.41
1996	.29
1997	.48
1998	.63
1999	.38

Average changes in global temperature in the 90's ...

Recent temperature changes (M = .3730) significantly exceed zero (μ=0),, t (9) = 9.588, p≤.05. The effect of global warming on temperature was very large, d=3.032.

$$d = \frac{|\bar{x} - \mu|}{\hat{s}_x} = \frac{.3730 - 0}{0.12302} = 3.032$$