Agenda for Monday, Nov ~~24~~ 25th 2024

Coming up

- Happy Thanksgiving!

Recall: In general, a hypothesis test will always consist of two contradictory hypotheses or statements, a decision based on sample data, and a conclusion.

claim

H_0 : null hypothesis (statement about μ or p that includes equality sign $=, \leq, \geq$)

H_a : alternative hypothesis ($\neq, <, >$)

Determine where the claim goes (H_o or H_a) and write the null and alternative hypothesis.

a) Sears claims that the average life of their car battery brand lasts more than 5 years.

Claim: $\mu > 5$ (since claim is not of the type $=, \leq, \geq$ we assign it to alternative hypothesis

H_o: $\mu \leq 5$

H_a: $\mu > 5$

b) An administrator claims that the success rate for MTH 142 is at most 75%.

Claim: $p \leq .75$

H_o: $p \leq .75$

H_a: $p > 0.75$

A hypothesis test will involve the following five steps:

Five Step p-value Method for Hypothesis Testing

1. Set up the null hypothesis and the alternative hypothesis
   - Claim: ____________
   - H_0: $=, \leq, \geq$
   - H_a: $\neq, <, >$

calculator functions STAT, Tests

2. Determine test value $(\underbrace{\text{Ztest, Ttest}}_{\text{for pop. mean } \mu}, \underbrace{\text{1-propZtest}}_{\text{for population proportion}})$

3. Calculate p-value

4. Draw conclusion:
   - Reject H_0 if p-value $\leq \alpha$ → α significance level
   - Fail to reject H_0 if p-value $> \alpha$

5. Interpret

Deciding which test value when testing mean (μ)

Ztest	**Ttest**
Use when: 1. Testing mean 2. σ is given σ is st. dev. of population	Use when: 1. Testing mean 2. s is given s is ______
Calculator Input (STAT, TESTS, Ztest) μ_0: value in H_0 σ: ______ $\bar{x}$: ______ given n: ______ μ: $\begin{cases} \neq \mu_0 \\ < \mu_0 \\ > \mu_0 \end{cases}$ highlight symbol in H_a Calculate	Calculator Input (STAT, TESTS, Ttest) μ_0: ______ $\bar{x}$: ______ s_x: ______ n: ______ μ: $\begin{cases} \neq \mu_0 \\ < \mu_0 \\ > \mu_0 \end{cases}$ Calculate
Output to look for: Test Value: z p-value: p	Output to look for: Test Value: ______ p-value: ______

Interpretation Review

Claim is H_0

Reject H_0: p value $\leq \alpha$

"There is enough evidence at ___% level of significance to reject the claim that ..."

Do Not Reject H_0: p value $> \alpha$

"There is Not enough evidence at ___% level of significance to reject the claim that ..."

Claim is H_a

Reject H_0: p value $\leq \alpha$

"There is enough evidence at ___% level of significance to support the claim that ..."

Do Not Reject H_0: p value $> \alpha$

"There is Not enough evidence at ___% level of significance to support the claim that ..."

Example 1. A random sample of 50 medical school applicants at a university has a mean raw score of 31 with a population standard deviation of 2.5 on the multiple-choice portions of the Medical College Admission Test (MCAT). A student claims that the mean raw score for the school's applicants is more than 30. Is there enough evidence to support the student's claim at a level of significance of 1%? → $\alpha = 0.01$

Step 1: Claim: $\mu > 30$

- H_0: $\mu \leq 30$ → μ_0 in calculator
- H_a: $\mu > 30$

Step 2: Determine test value: function in calculator $\boxed{\text{zTest}}$

Given values:	**Calculator Input:**
$n = 50$	μ_0 → value in H_0
$\bar{x} = 31$	$\sigma = 2.5$
$\sigma = 2.5$	$\bar{x} = 31$
$\alpha = 0.01$	$n = 50$

Step 3: p-value = 0.0023 $z = 2.8284$

Step 4: Conclusion: pvalue $= 0.0023 \leq 0.01$ true, we reject H_0

Step 5: Interpretation:

There is enough evidence at 1% level of significance to support the student's claim that the mean raw score of applicants is more than 30 on the MCAT.

Example 2. A doctor, working at a busy city hospital, is interested in studying the ages of patients who visit the hospital. He claims that the mean age of patients who arrive at the emergency room is greater than 46 years old. A sample of 40 patients had a mean age of 49 years old with a standard deviation of 10 years. Use level of significance of 5%.

Step 1: Claim: $\mu > 46$

- H_0: $\mu \le 46$
- H_a: $\mu > 46$

Step 2: Determine test value : use Ttest in calculator bc $s = 10$

t

Given values:	**Calculator Input:**
$n = 40$	
$\bar{x} = 49$	
$s = 10$	
$\alpha = 0.05$	

Step 3: p-value = 0.033 $t = 1.89$

Step 4: Conclusion: pvalue ? α $0.033 \le 0.05$ reject H_0

Step 5: Interpretation:

There is enough evidence at 5% significance level to support the claim that the average age at ER is greater than 46 years old.

Example 3. Statistics students believe that the mean score on the first statistics test is 65. A statistics instructor thinks the mean score is higher than 65.

To test his claim, he selects a random sample of ten statistics students and obtains the scores: 65, 65, 70, 67, 66, 63, 63, 68, 72, 71.

He uses this data to conduct a hypothesis test using a 5% level of significance. The data are assumed to be from a normal distribution. Does this sample data provide evidence that the mean score for *all* students is more than 65?

Step 1: Claim: ______________________

- H_0: $H_0 \leq 65$
- H_a: $\mu > 65$

Step 2: Determine test value : Ttest

Given values:	**Calculator Input:**
____________	L1
____________	____________
____________	____________
____________	____________

Step 3: p-value = 0.0396 ≤ 0.05 reject Ho

Step 4: Conclusion: ______________________

Step 5: Interpretation: ______________________

One Proportion Z-Test

Calculator Input (STAT, TESTS, 1propZtest) p_0 : x: prop: $\neq p_0 < p_0 > p_0$ Calculate
Output to look for Test Value: z p-value: p

x → number of successess

$\hat{p} = \frac{x}{n}$ sample proportion

p = population proportion

Example 4. A medical researcher claims that less than 25% of US adults are smokers. In a random sample of 200 US adults, 18.5% say that they are smokers. At $\alpha = .05$, test the researcher's claim.

Step 1: Claim: $p < .25$

- H_0: $p \geq .25$
- H_a: $p < .25$

Step 2: Determine test value : function 1 prop Z-Test

Given values:	Calculator Input:
$n = 200$	p_0
$\hat{p} = .185$	$x = \hat{p}n$ → round up to nearest integer
$\alpha = 0.05$	

$z = -2.1229$

Step 3: p-value = 0.0169

Step 4: Conclusion: $0.0169 \leq .05$ we reject H_0

Step 5: Interpretation:

This is enough evidence at 5% significance level that the proportion of adult smokers is less than 25%.

Example 5. A medical researcher claims that less than 5% of children under 18 years of age have asthma. In a random sample of 25 children under 18 years of age, 9.6% say they have asthma. Using a level of significance of 5%, is there enough evidence to reject the researcher's claim?

Step 1: Claim: $p < 0.05$

- H_0: $p \geq 0.05$
- H_a: $p < .05$

Step 2: Determine test value : 1PropZTest

Given values:	Calculator Input:
$n = 25$	$p_0 = .05$
$\hat{p} = .096$	$x = \hat{p}n = (0.096)(25) = 2.4 = 3$
$\alpha = .05$	

Step 3: p-value = $0.9459 > 0.05$

Step 4: Conclusion: we fail to reject Ho

Step 5: Interpretation: There is NOT enough evidence at 5% S.L. to support the claim that less than 5% of of childre have asthma.

The Hypothesis Testing Process