

Stat 101L: Lecture 34

Test of Hypothesis for μ

- *Could the population mean heart rate of young adults be 70 beats per minute or is it something higher?

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Test of Hypothesis for μ

- *Step 1: State your null and alternative hypotheses.

$$H_0 : \mu = 70$$

$$H_A : \mu > 70$$

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Test of Hypothesis for μ

- *Step 2: Check conditions.
 - Randomization condition, met.
 - 10% condition, met.
 - Nearly normal condition, met.

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Test of Hypothesis for μ

*Step 3: Calculate the test statistic and convert to a P-value.

$$t = \frac{\bar{y} - \mu_0}{SE(\bar{y})}$$

$$SE(\bar{y}) = \frac{s}{\sqrt{n}}$$

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Summary of Data

* $n = 25$

* $\bar{y} = 74.16$ beats

* $s = 5.375$ beats

* $SE(\bar{y}) = \frac{s}{\sqrt{n}} = 1.075$ beats

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Value of Test Statistic

$$t = \frac{\bar{y} - \mu_0}{SE(\bar{y})} = \frac{74.16 - 70}{1.075}$$

$$t = 3.87$$

Use Table T to find the P-value.

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Table T

One tail probability	0.10	0.05	0.025	0.01	0.005	P-value
df						
1						
2						
3						
4						
⋮						
24			2.064	2.492	2.797	3.87

The P-value is less than 0.005.

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Test of Hypothesis for μ

- *Step 4: Use the P-value to reach a decision.
- *The P-value is very small, therefore we should reject the null hypothesis.

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Test of Hypothesis for μ

- *Step 5: State your conclusion within the context of the problem.
- *The mean heart rate of all young adults is more than 70 beats per minute.

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Alternatives

$$H_0 : \mu = \mu_0$$

$$H_A : \mu < \mu_0, \text{ One tail prob (Pr } < t)$$

$$H_A : \mu > \mu_0, \text{ One tail prob (Pr } > t)$$

$$H_A : \mu \neq \mu_0, \text{ Two tail prob (Pr } > |t|)$$

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JMP: Analyze – Distribution

* Test Mean

			t-test
Hypothesized value	70	Test statistic	3.87
Actual Estimate	74.16	Prob > t	0.0007
df	24	Prob > t	0.0004
Std Dev	5.375	Prob < t	0.9996

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Example

- * What is the mean alcohol content of beer?
- * A random sample of 10 beers is taken and the alcohol content (%) is measured.

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Sample Data – Alcohol (%)

Molson Canadian	5.19	Heineken Dark	5.17
Michelob Dark	4.76	O'Keefe Canadian	4.96
Big Barrel Lager	4.32	Olympia Lager	4.78
Hamm's	4.53	Miller Draft	4.85
Tsingtao	4.79	Guinness Stout	4.27

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Test of Hypothesis for μ

- *Step 1: State your null and alternative hypotheses.

$$H_0 : \mu = 5$$

$$H_A : \mu \neq 5$$

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Test of Hypothesis for μ

- *Step 2: Check conditions.
 - Randomization condition, met.
 - 10% condition, met.
 - Nearly normal condition, met.

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Test of Hypothesis for μ

*Step 3: Calculate the test statistic and convert to a P-value.

$$t = \frac{\bar{y} - \mu_0}{SE(\bar{y})}$$

$$SE(\bar{y}) = \frac{s}{\sqrt{n}}$$

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Test of Hypothesis for μ

*Test statistic,

$$t = \frac{\bar{y} - \mu_0}{\left(\frac{s}{\sqrt{n}}\right)} = \frac{4.762 - 5}{\left(\frac{0.314}{\sqrt{10}}\right)} = \frac{-0.238}{0.0993} = 2.397$$

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Table T

Two tail probability	0.20	0.10	0.05	P-value 0.02
df				
1				
2				
3				
4				
⋮				
9			2.262	2.397 2.821

The P-value is between 0.02 and 0.05.

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Test of Hypothesis for μ

- *Step 4: Use the P-value to reach a decision.
- *The P-value is smaller than 0.05, therefore we should reject the null hypothesis.

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Test of Hypothesis for μ

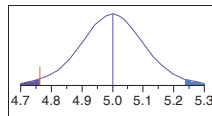
- *Step 5: State your conclusion within the context of the problem.
- *The population mean alcohol content of beer is not 5%.

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JMP Output

Moments

Mean	4.762
Std Dev	0.3142823
Std Err Mean	0.0993848
upper 95% Mean	4.986824
lower 95% Mean	4.537176
N	10



Test Mean=value

Hypothesized Value	5	Test Statistic	-2.3947	t Test
Actual Estimate	4.762	Prob > t	0.0402	
df	9	Prob > t	0.9799	
Std Dev	0.31428	Prob < t	0.0201	

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Confidence Interval for

$$\bar{y} - t^* \left(\frac{s}{\sqrt{n}} \right) \text{ to } \bar{y} + t^* \left(\frac{s}{\sqrt{n}} \right)$$

$$4.762 - 2.262 \left(\frac{0.314}{\sqrt{10}} \right) \text{ to } 4.762 + 2.262 \left(\frac{0.314}{\sqrt{10}} \right)$$

$$4.762 - 0.225 \text{ to } 4.762 + 0.225$$

$$4.537 \text{ to } 4.987$$

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Interpretation

- * We are 95% confident that the population mean alcohol content of beer is between 4.537% and 4.987%.

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Interpretation

- * The population mean alcohol content of beer could be any value between 4.537% and 4.987%.
- * If we repeat the procedure that produces a confidence interval, 95% of intervals produced will capture the population mean.

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